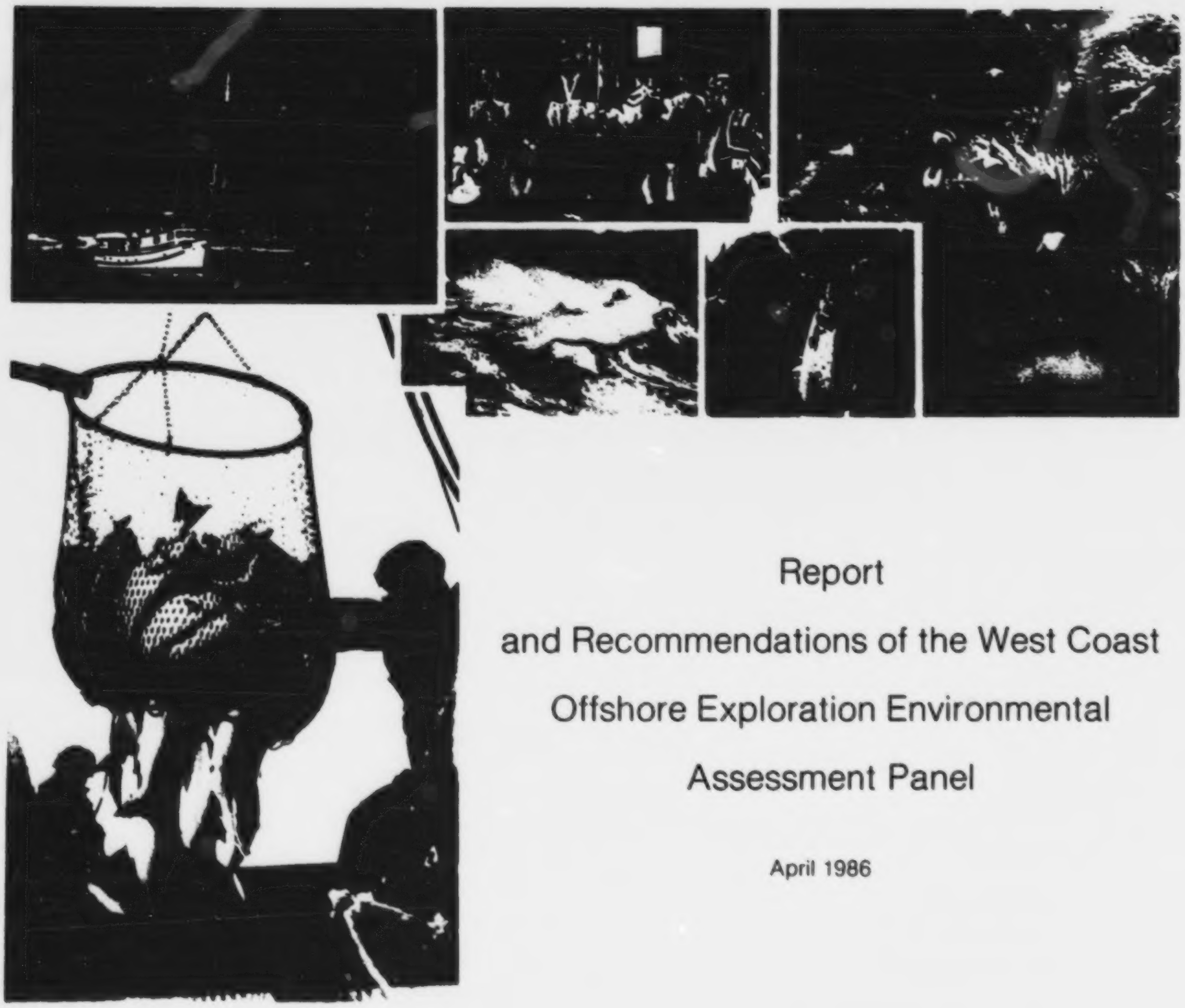
OFFSHORE HYDROCARBON EXPLORATION



Report

and Recommendations of the West Coast Offshore Exploration Environmental Assessment Panel

April 1986

Canada

Province of
British Columbia

OFFSHORE HYDROCARBON EXPLORATION

Hippa Island, Queen Charlotte Islands

Report

West Coast Offshore Exploration

Environmental Assessment Panel

April 1986

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Government of Canada Gouvernement du Canada

Province of British Columbia

The Honourable Tom McMillan
Minister of the Environment
The Government of Canada
Ottawa, Ontario

and

The Honourable Pat Carney
Minister of Energy, Mines
and Resources
The Government of Canada
Ottawa, Ontario

The Honourable F.C. Austin Pelton
Minister of Environment
Government of British Columbia
Victoria, B. C.

and

The Honourable Tony Brummet
Minister of Energy, Mines and
Petroleum Resources
Government of British Columbia
Victoria, B. C.

Dear Ministers:

In accordance with the Terms of Reference provided to the West Coast Offshore Exploration Environmental Assessment Panel a public review of possible offshore hydrocarbon exploration off Canada's West Coast has been completed. We are pleased to submit the Panel Report for your consideration.

As requested, we have assessed the potential environmental and socio-economic effects, identified broad terms and conditions for seismic surveys and exploratory drilling, specified information and investigative requirements for the respective stages of offshore activity, and identified issues that should be examined before possible development and production occurs.

Respectfully yours,

Ewan Cotterill
Chairman
West Coast Offshore Exploration
Environmental Assessment Panel

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EXECUTIVE SUMMARY

In June 1984, the federal and British Columbia Ministers of Environment appointed a five member Environmental Assessment Panel to conduct a public review of the environmental and related socio-economic effects of a potential renewal of a program of petroleum exploration off the west coast of Canada, north of Vancouver Island. The West Coast Offshore Exploration Environmental Assessment Panel was asked to develop recommendations on the terms and conditions under which petroleum exploration could proceed in a safe and environmentally responsible manner.

During the course of the review, the Panel gathered information on the environmental and related socio-economic effects of the proposed offshore exploration program and held two series of public forums. These were public information meetings held in November 1984 and public hearings held in September, October and November 1985. Opportunities for full public participation were key elements in the review process, and included the scheduling of many of the public meetings in the north coast communities of British Columbia that could be most directly affected.

Both Chevron Canada Resources Ltd. and Petro-Canada Inc., who acted as proponents for the purpose of this review, hold rights to exploration licences in the coastal waters between northern Vancouver Island and the border between Alaska and British Columbia. A government-imposed moratorium on all exploration drilling in the region has been in place since the early 1970's. However, consideration is now being given to lifting the moratorium so that exploration programs can be pursued.

Chevron participated fully in the Panel review process, however, Petro-Canada withdrew from the review in November 1984, explaining that it had other and higher priorities.

Chevron's proposed exploration program consists initially of two years of seismic surveys followed by a two-well drilling program, using a semi-submersible anchored drill unit. Depending on the results of this initial program, a more intense exploration or delineation program might be undertaken consisting of additional seismic surveys and drilling more exploratory wells.

The areas proposed for exploration include Queen Charlotte Sound, Hecate Strait, Dixon Entrance and some of the coastal waters west of Graham Island. The area is rich and diverse in natural resources, is subject to extreme weather conditions and is sparsely populated.

Aside from the major population centres of Prince Rupert and Port Hardy, a sizeable percentage of the area's population are native people. Most of these people have strong cultural and economic ties to the ocean and its resources. Many of the smaller native communities rely almost exclusively on the sea and its resources for their sustenance which comes from commercial fishing and from the extensive use of locally gathered seafoods in their diets.

The most important industry in the region is the fishing industry. This provides employment in the commercial harvest and processing of many species. Indeed the size and distribution of the region's population has been largely maintained by fishing. In addition to the commercial fishery, the region also has an important sport fishery and will probably, in the future, support a strong mariculture industry.

During the course of the review, participants raised a variety of concerns relating to the potential environmental and related socio-economic effects of renewed offshore oil and gas exploration. The major concerns were the biophysical and socio-economic impacts associated with the level of risk and potential occurrence of a major oil well blowout. Other significant concerns and issues raised included:

—social and cultural impacts on the area's residents;

—biophysical effects associated with seismic surveying and routine exploratory drilling operations;

—compensation programs for losses and damages resulting from a major oil blowout;

—additional study and research needed to properly understand interactions between proposed exploration and the region's environment; and

—government's ability to manage an offshore exploration program.

After careful consideration of these and other issues and concerns, the Panel has reached the following main conclusions :

1. a two year seismic survey program such as that proposed by Chevron may proceed providing certain terms and conditions are met; however, other programs should not be permitted until monitoring results from the initial program are analyzed to better determine the effects of seismic operations on fish eggs, larvae and juvenile fish;

2. exploratory drilling may not take place within an exclusion zone of 20 km from any point of land, to minimize potential impacts on sensitive nearshore areas from routine operations or from an oil well blowout;

3. additional information leading to a better understanding of the environment of the exploration area and the potential impacts of an exploration program must be gathered and provided to the regulatory authority prior to the commencement of offshore drilling;

4. exploratory drilling outside the specified 20 km exclusion zone must be initially confined to the months of June to October inclusive, at least until further operating experience is obtained and weather forecasting capability is improved;

5. the major source of socio-economic impact of an offshore exploration program is likely to arise from the limited ability of residents of the area, including the native people, to participate in decisions relating to the management of the area's resources;

6. an effective ongoing environmental management structure must be put in place that is capable of managing decisions relating to the environmental and socio-economic considerations of offshore hydrocarbon exploration and of possible development and production as it may evolve; and

7. an effective compensation program that applies to all losses and damages resulting from an oil blowout or from routine operations should be established before the start of offshore exploration activity.

The foregoing major conclusions are reflected in the detailed recommendations in the Panel report. These recommendations include appropriate terms and conditions which should be put in place before and during the exploration program to minimize adverse effects and to address issues requiring further investigation and study. Also included in the Panel report are recommendations on the establishment and structure of an appropriate management system to deal with the environmental and socio-economic matters associated with west coast offshore hydrocarbon exploration and eventually development and production.

1. BACKGROUND

MANDATE

In September 1983, a Memorandum of Agreement signed by the Governments of Canada and British Columbia established the basis for a joint federal-provincial public review of the potential environmental and related socio-economic effects of renewed west coast offshore oil and gas exploration. Under this agreement the federal and provincial Ministers of Environment were requested to establish a formal public review.

The review has been conducted under the federal Environmental Assessment and Review Process and the British Columbia Environment Management Act. The process was administered jointly by the two levels of government.

The area under review includes British Columbia coastal waters between 50° 40'N latitude and 54° 40'N latitude, that is, from the northern end of Vancouver Island to the border between British Columbia and Alaska and seaward to the limit of the continental shelf. Although northern Vancouver Island and southeastern Alaska are outside the proposed exploration area, the Panel believes that the potential effects upon these areas must also be considered. See Figure 1 for review area.

In June 1984, the federal and provincial Ministers of Environment appointed the five-member West Coast Offshore Exploration Environmental Assessment Panel as an independent advisory body to conduct this public review. The Panel consists of Ewan Cotterill (Chairman), Charles Bellis, Peter Gelpke, Allen Milne and Norman (Sonny) Nelson.

The Panel's Terms of Reference ask it "to examine the environmental and directly related socio-economic effects of offshore petroleum exploration, and to present recommendations on the terms and conditions under which offshore petroleum exploration could proceed in a safe and environmentally responsible manner." In interpreting its Terms of Reference, the Panel defined exploration to include seismic surveying, exploratory drilling and the delineation drilling that would occur to establish favourable conditions for a development and production program to be proposed. The Terms of Reference named Chevron Canada Resources Limited and Petro-Canada Incorporated as proponents.

The Panel asked the proponents and the governmental regulatory agencies to consider various degrees of

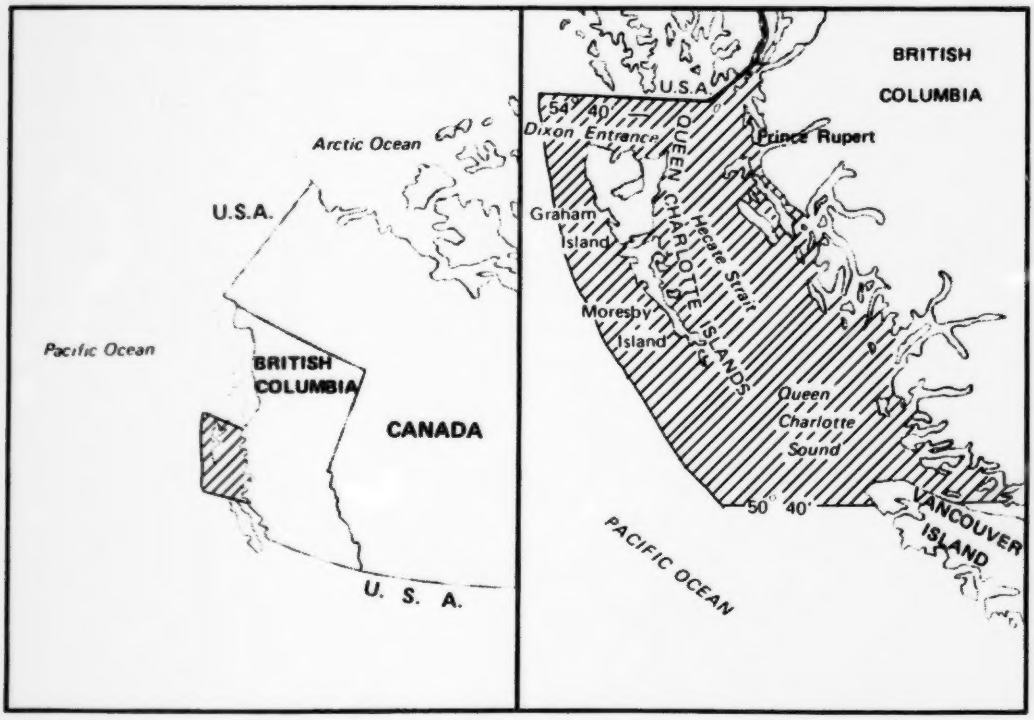


Figure 1: Area Under Review

expanded exploration and their likely timeframe, so that the Panel would have a better understanding of future exploration possibilities. The effects of such an expanded exploration activity upon the environment and on the socio-economic framework of the region were then to be addressed.

The Panel was not asked to assess the effects of oil tanker traffic, however, the Panel's mandate did extend to the identification of oil transportation issues as they relate to eventual development and production.

The Terms of Reference required the Panel to submit a written report of its findings to the federal and provincial Ministers of Environment. The Panel was asked to include the following in its report:

- —identify seasonal and regional concerns associated with offshore exploration;
- —identify any information gaps that might prevent a full assessment of risks and impacts; and
- —recommend terms and conditions under which exploration might proceed in a safe and environmentally responsible manner, if decisions were made to resume exploratory drilling activity.

These Terms of Reference were amended in December 1984 to address the withdrawal of Petro-Canada from the review, and in May 1985 to extend the Panel's reporting date in order to allow the public more time to prepare for the public hearings.

REVIEW PROCESS

Along with its Terms of Reference, the Panel was provided with four documents as background information for the public review:

- —Chevron Canada Resources Ltd. 1982. Initial Environmental Evaluation for Renewed Petroleum Exploration in Hecate Strait and Queen Charlotte Sound. Volumes 1 and 2;
- —Petro-Canada Inc. 1983. Offshore Queen Charlotte Islands : Initial Environmental Evaluation. Volumes 1, 2 and 3;
- —British Columbia Ministry of Environment. 1983. Offshore Hydrocarbon Exploration and Development: A Preliminary Environmental Assessment; and
- —Canada Oil and Gas Lands Administration and British Columbia Ministry of Energy, Mines and Petroleum Resources. 1984. Technical Evaluation of the IEEs for Offshore Petroleum Exploration — January 17/18, 1984.

In July 1984, the public was invited to review these background documents and make submissions by September 27, 1984 indicating what additional information should be made available for the review. On the basis of these submissions and its own review, the Panel, in early October 1984, released to government, Chevron and Petro-Canada an initial list of additional information requirements. Just before the Panel began its series of public information meetings in November 1984, Petro-Canada formally withdrew from further participation in the public review.

A series of public information meetings was held in 15 communities in the north coast area and in Vancouver and Victoria during November 1984 to allow discussion of the review process, the proposed offshore exploration activities and additional information requirements.

In early December 1984, the Panel released a document identifying information it needed from government and industry: "Requirements for Additional Information". The responses to this document were received in February 1985, and the first stage of the review was completed.

Although many individuals and organizations had been scrutinizing material from the outset of the review, the months from March 1985 through August 1985 were set aside to allow participants to prepare for the hearings. The hearings, originally scheduled for May and June 1985, were rescheduled to September, October and November 1985 to allow intervenors not only to have more time to prepare for the hearings, but also to seek funding, and to avoid most conflicts with the fishing season.

Early in the review, the Panel adopted measures to encourage full participation by residents of the widely dispersed British Columbia coastal communities. A mailing list of interested individuals and groups grew from 300 entries in June 1984 to over 1,800 entries by February 1986. The Panel produced and distributed six issues of its newsletter (Panel News), special bulletins and releases at intervals to inform the public about the review and to encourage public participation. It also established a network of information depots (179 in July 1985) in communities of the region and supplied them with documents associated with the review. These depots included public libraries, schools, colleges and local government offices. The latter included the offices of regional districts, communities, band councils and government agents. Finally, the Panel Secretariat visited the communities to provide information and to assist them in participating in the review.

The Panel visited the North Sea in the autumn of 1984 to observe active oil and gas exploration and production and to discuss lessons learned by government and industry in the United Kingdom and Norway. The North Sea was selected because of features similar to Canada's west coast, particularly coastline, sea energy, climate, fisheries and human settlement patterns. During this visit, the Panel met with the Shetland Islands Council to discuss its management of the environmental and social impacts associated with North Sea petroleum development.

The Panel Secretariat visited Ketchikan, Juneau and Anchorage, Alaska to inform community, state and federal officials of the Panel's review and to obtain any information on terms and conditions currently used in Alaska for managing oil and gas exploration activity.

WITHDRAWAL OF PROPONENT

For this review, Petro-Canada and Chevron were designated by the federal and provincial regulatory bodies as proponents of the offshore oil and gas exploration activity. As proponents, they were expected to develop information on environmental and socio-economic effects that might result from exploration activity in the area of their interest, and to explain and answer questions related to this information during the public hearings.

On November 2, 1984, Petro-Canada withdrew from the review process. This presented the Panel with a number of difficulties. First, some of the additional information the Panel needed for its review could not be obtained. Second, the information already provided by Petro-Canada in its Initial Environmental Evaluation could not be directly examined during subsequent public hearings. Third, the possibility existed that the credibility of the review suffered.

To many, the withdrawal of a proponent, without any apparent effect upon its holdings or future plans for operations within the area, cast into doubt the government's commitment to the environmental review process. For others, it called into question the ability of regulatory bodies to control the industry. In addition, some members of the public interpreted the withdrawal of Petro-Canada as an indication of Petro-Canada's lack of commitment to the principles of environmental management. While deploring the arbitrary and insensitive action of Petro-Canada, the Panel believes that this withdrawal from the review process did not significantly affect its ability to achieve the major objectives of the review.

If this had been a conventional environmental assessment review carried out to examine a specific and well-defined project, the withdrawal of an industrial proponent would have been critical. However, the Panel was not assessing a specific project, but was reviewing generally the introduction of a new type of industrial activity into a large geographic area. The Panel had to examine a wide range of possible activities, including those that exceeded the immediate plans of declared proponents or of others that could ultimately be engaged in offshore exploration. In such a situation, the industrial proponent's participation is not critical. In fact, in this type of review, individual industrial proponents would not be in a position to provide all of the information needed to make appropriate judgements.

The Panel believes that this type of review, conducted before a new industrial activity is introduced into an area, is essential to good environmental management. Such a review should be seen as the first step in a process of environmental planning and management. However, for such reviews, it is inappropriate to identify a specific industrial proponent to carry the burden of generating the information needed for the review on behalf of the industry as a whole, or to be asked to defend a level of activity that far exceeds its current or long-term plans and intentions.

In the Panel's view, Chevron is to be commended for its willingness to continue participation. Chevron had anticipated a review that would consider only its limited exploration program. Instead it was required to serve as the sole proponent for a full-scale and long-term exploration program, and to do this even though it was only one of several interest holders in the area, and only one of two companies with an active interest in exploration.

The Panel believes that information requirements for this type of review should be provided by government, not industry. Since government is considering allowing the activity to take place, government should be considered the proponent. Industry involvement is appropriate at a later stage when specific projects have been developed and need to be assessed.

> **The Panel recommends that public environmental assessment reviews of broad industrial activities proposed within large geographic regions be conducted in such a manner that government, through interdepartmental coordination, be required to prepare the environmental impact statement, and to present this information in the appropriate forum for public review.**

The Panel concludes that the withdrawal of a proponent from a public environmental review leads inevitably to a loss of credibility for that process. Even more serious is the perception that government is unable to exercise control over that proponent in terms of its compliance with public policy.

The Panel recommends that a specific industry proponent not be designated for environmental assessment reviews unless the regulatory agencies have the capacity to enforce the proponent's continued participation.

INTERVENOR FUNDING

Members of the public exhibited a high level of interest in the issues being considered by the Panel, but their participation in the process was constrained by the limited resources available to them. This was particularly true in the many small, remote communities near the area of contemplated exploration. To take part effectively, participants had to review a tremendous amount of information, produce briefs containing community concerns and views, and travel to hearings. These communications and travel demands placed a great strain on the limited human and financial resources of these communities.

For this reason, and because of the importance the Panel attached to carrying out a full public review as required by its Terms of Reference, the Panel, on November 4, 1984, wrote to the federal and provincial Ministers of Environment in support of the provision of some form of intervenor funding.

Because neither government was able to respond favourably, the Panel attempted to assist the public. It provided limited travel assistance, technical specialists for advice and information and clerical assistance to help develop presentations. It also conducted community workshops to prepare residents for community and general hearings.

Some native groups, the Council of the Haida Nation, the Nisga'a Tribal Council, the Kwakiutl District Council and the Kitsumkalum Band, also received some financial assistance from the Department of Indian Affairs and Northern Development through its Resource Development Impact Program.

The Panel believes that some level and form of intervenor funding is an important and necessary element of a public review process. For the public to participate effectively in the review process, communities and organizations in the region potentially affected must be able to analyze information provided to them and to relate it to their own concerns, experience and knowledge. They must be able to identify potential impacts and suggest how they should be dealt with. They must also be able to develop and present their views in an organized and helpful fashion. Inevitably, the human and financial resources available to meet these requirements are inadequate. Some form of financial assistance is needed to fill the gap.

The Panel also believes that groups within the area of potential impact should be given priority for any financial assistance provided under a program of intervenor funding. In all cases, organizations seeking assistance should be required to demonstrate a direct, relevant interest and a financial need.

The Panel recommends that:

1. **the Governments of Canada and British Columbia develop policies on intervenor funding for formal public reviews that will enable funds to be made available to communities and organizations to participate effectively in public review processes; and**
2. **financial assistance be directed to communities and groups to help them analyze and understand existing information, to develop and articulate positions and concerns, and to organize and present their own briefs.**

> *"... we see funding for intervenors as extremely important and we see it even more extremely important when you're looking at the capital that is backing Petro Canada, and Shell, Chevron, as compared to the capital that is backing groups that may oppose offshore oil drilling ..."(Joy Thorkelson, Prince Rupert Labour Council, Prince Rupert, November 1984)*

EXTERNAL ISSUES

In many small communities, the Panel's hearings provided a rare opportunity for people to present views and concerns directly to government. Several issues raised were outside the Panel's mandate, but the Panel believes that these should be brought to the attention of government.

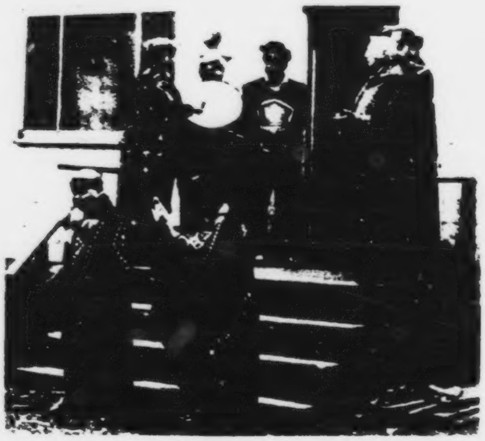
LAND CLAIMS

Although land claims are clearly outside the mandate of the Panel, it would be impossible to visit the native communities of the coast without encountering this issue. It dominates the political attitudes of native people throughout the region. Given the level of concern expressed sincerely, consistently and firmly throughout the public hearings, the Panel believes it must underline the importance of this issue to government.

Land claims should be understood as the drive by native peoples to formalize, through negotiation, traditional rights and land and sea title arising from aboriginal use and occupancy. Having these rights formalized is an objective that supercedes all others within native communities visited by the Panel.

Native people believe strongly that their aboriginal title and aboriginal rights have never been surrendered, but have been eroded over time by the encroachments of non-native people. They believe that, before further erosion occurs, negotiations must take place to define and formalize traditional rights and to protect aboriginal title.

Arising from a rich and traditional society and culture, drawing from a strong sense of right and urgency, and supported by a young and increasingly sophisticated leadership, the issue of aboriginal claims will only increase in importance as will its potential for serious conflict. It will demand an ever-increasing level of attention from governments and native peoples and deserves to be given a much higher place on the public policy agenda for the region.



Fort Rupert

"... we the Tsimpsian Nation hereby assert our aboriginal rights to the land and waters and the right to the preservation, development management and to the benefits that have been and may be derived from all resources and development within our tribal territories, including air and subsurface areas." (P. Starr, Chief, Klemtu, November 1984)

ENERGY NEEDS

Many intervenors believed that the need for west coast offshore oil and gas should be established before any of the risks associated with offshore exploration are accepted. Some suggested that the Panel ought to deal with this issue and that its Terms of Reference should be expanded accordingly.

The Panel does not agree with this view. Since the Panel's Terms of Reference ask it to advise the governments on the environmental and socio-economic effects of exploration, it is reasonable to assume that the governments either accept the need for additional energy sources or intend to examine that need in some other forum. The Panel also believes that an examination of energy needs within its review would fundamentally alter the nature of that review, and hinder a full consideration of the equally important, but unrelated, environmental and socio-economic issues and concerns.

"I have a credit card in my back pocket with a Chevron sticker on it, you know. I mean we're all using fuel; if it's not for heating your home or driving your vehicle or whatever, and I'm not saying no oil drilling. I'm just saying it should be taken a lot more care and there's no reason to highball everything through when there's not a need." (Colin Skinner, Village Councillor, Alert Bay, November 1984)

PRODUCTION AND DEVELOPMENT

Participants frequently suggested that the Panel's Terms of Reference should be expanded to include a detailed assessment of development and production issues, since a decision to allow offshore exploration for oil and gas would in all likelihood lead to production if oil or gas were discovered.

While this position has much to be said for it, in practice it would be difficult to achieve. Conducting a comprehensive review of offshore exploration in the absence of site-specific proposals, places severe limitations and constraints upon the review process and requires substantial dependence on hypothetical formulations to develop an information base for the analyses. The further the activity being reviewed is pushed into the future, the more hypothetical the situations become.

The Panel would have to define and assess a hypothetical development and production activity before oil or gas had been proven to exist in commercial quantities. The type of hydrocarbons would have to be hypothesized, as would the location, depth and areal size of field, extent of reserves, method of production and transportation and other vital elements of a comprehensive review.

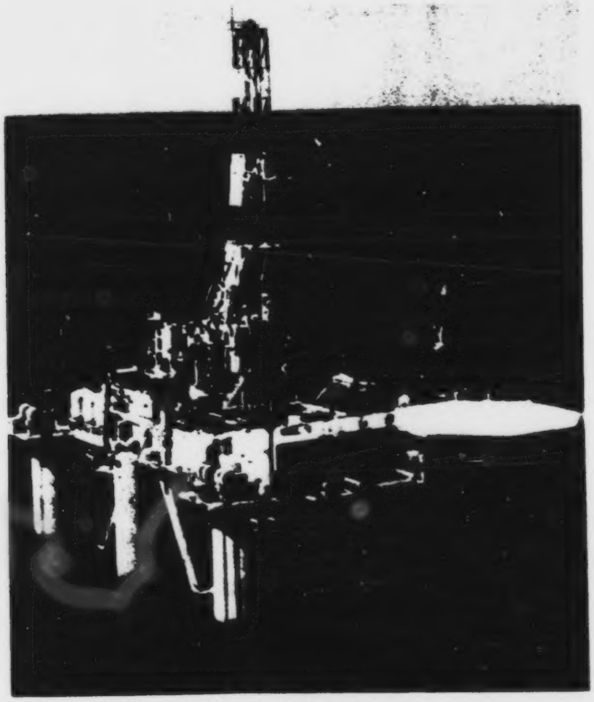
For these reasons, the Panel concluded that expanding its mandate as suggested would have been impractical. Furthermore, the Panel recognized that governments are committed to carrying out a full public review of the environmental and socio-economic effects of development and production before approving that phase of hydrocarbon activity.

The Terms of Reference did direct the Panel to identify issues that would ultimately have to be considered should production become feasible at some time in the future, which the Panel has done.

JURISDICTION

The West Coast Offshore Exploration Environmental Assessment Panel was established pursuant to the agreement of September 8, 1983 between the Government of Canada and the Government of British Columbia. This agreement expressly states that it "... is without prejudice to resource ownership and jurisdiction, to any future agreement which may be reached respecting offshore resource management, and to any future agreement which may be reached on sharing of revenues from offshore oil and gas activity ... ". In turn, when issuing Terms of Reference to the Panel, the Ministers of Environment for Canada and British Columbia stated, "The Panel shall preclude from its review questions of ... jurisdiction ...".

Throughout its review, the Panel was aware of the various claims to the area by the governments of British Columbia and Canada and those of a number of aboriginal nations. Nevertheless, the Panel conducted its review in keeping with its Terms of Reference and in the belief that the environmental and socio-economic effects associated with possible petroleum exploration off the west coast, and any terms and conditions required to offset or control these, would be the same regardless of jurisdiction.



Semi-submersible drilling unit

2. OFFSHORE OIL AND GAS EXPLORATION

PROPOSAL

Chevron Canada Resources Limited and Petro-Canada Inc. both hold rights to exploration licences in the offshore areas of the northern mainland and Queen Charlotte Islands regions. Both companies have recently proposed to explore for hydrocarbons in that area.

The Petro-Canada program is uncertain at present due to the company's position as stated at the time it withdrew from the environmental review process. That withdrawal is discussed in Section 1.

Chevron seeks approval to explore for oil and gas in Hecate Strait and Queen Charlotte Sound. It proposes to conduct 5,200 km of seismic surveys, followed by drilling two exploratory wells. At least two summers of seismic surveys could occur before drilling and seismic survey operations might continue into later stages. Approximately 130 days would be required to drill the wells. Subsequent exploration proposals would depend upon encouraging results from this initial program.

Petro-Canada holds exploration rights in Dixon Entrance. Petro-Canada also holds similar rights on scattered blocks on the boundaries of the Chevron area and on the Pacific Ocean side of the northern end of the Queen Charlottes Islands.

HISTORY

A team led by Richfield Oil Corporation conducted the first oil and gas exploratory activity in the review area in 1958. They tested the Queen Charlotte geological basin to the base of the Tertiary by drilling five onshore wells on Graham Island in the Queen Charlotte Islands. This drilling program was followed by marine seismic surveys in Hecate Strait. In 1960, seismic surveys were conducted onshore, followed by the drilling of a sixth well in 1961. Thick Tertiary sediments with underlying volcanics were found, but there were no encouraging indications of the presence of hydrocarbons.

In 1961, Shell Canada Limited began acquiring exploration permits for offshore areas in Hecate Strait, Queen Charlotte Sound and on the continental shelf off the western coast of Vancouver Island. By 1968, its holdings totalled 4.9 million hectares, with about 3.5 million hectares situated in Hecate Strait and Queen Charlotte Sound. Between 1963 and 1967, Shell conducted geological mapping and offshore seismic surveys, and between 1967 and May 1969, drilled 14 wells on a year-round basis on these permits. Eight of these were in the Hecate Strait - Queen Charlotte Sound area. These wells provided a considerably enhanced understanding of the geology of the Queen Charlotte Tertiary basin, most of the wells having penetrated the full Quaternary and late and early Tertiary sections. Minor shows of oil and gas were encountered in late Tertiary sediments in four of the eight wells.

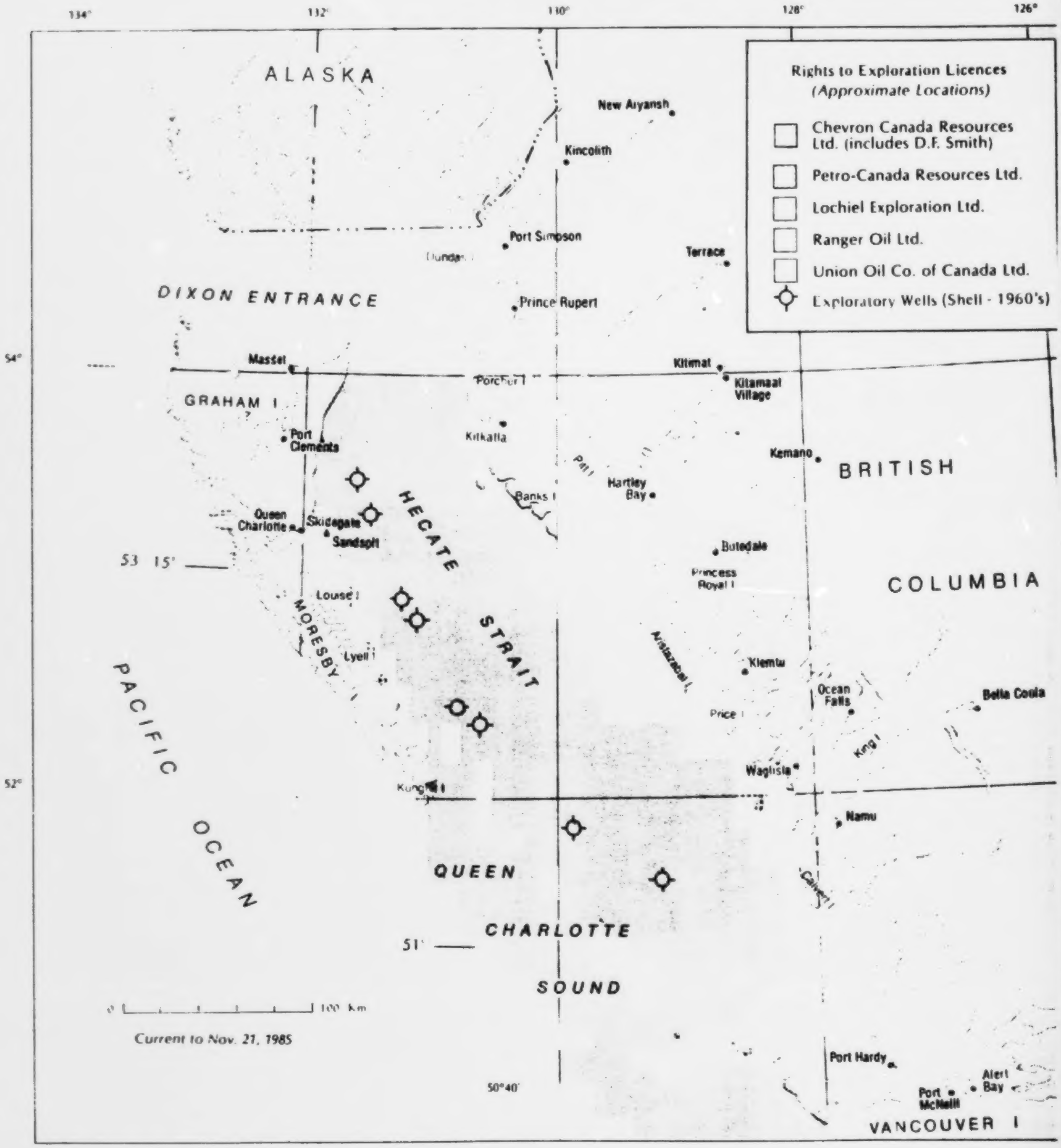
In 1970, Shell entered into a farm-out agreement with Chevron Canada Resources Limited whereby Chevron would earn an interest in the Shell offshore area by conducting seismic surveys and by drilling two deep exploratory wells.

WEST COAST MORATORIUM

In 1972, the federal government imposed a moratorium to prevent crude oil tankers travelling through the Dixon Entrance, Hecate Strait and Queen Charlotte Sound enroute from the Trans-Alaska pipeline terminal at Valdez, Alaska. Subsequently, a federal Order-in-Council indefinitely relieved existing offshore exploration permit holders from their obligations to conduct exploratory drilling in these waters and prohibited any further drilling.

In 1981, the Province of British Columbia reinforced the moratorium when it declared an Inland Marine Zone. At the same time, an indefinite moratorium was placed on offshore exploration in Johnstone Strait south of Telegraph Cove, and in the Straits of Georgia and Juan de Fuca. As of February 1986, all of these respective moratoria are still in effect.

> *"I think as long as the moratorium is in place it gives us the protection, it gives us the power, I suppose, to insist from the oil companies that they do their homework, that they do it specifically in regards to the ocean currents of the Pacific, the tidal currents, the prevailing winds, the migration routes of the salmon because even in that area, although the resource, the salmon resource has been managed for many, many years, there is precious little known by the fisheries about the exact timing and the migration routes and patterns of the salmon, or among the other species, which are ever less visible, the shellfish, and the bottom fish." (Cecil Reid, Bella Bella Band Council, Waglisla, Sept. 1985)*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51°
50°40'
Rights to Exploration Licences
(Approximate Locations)
☐ Chevron Canada Resources Ltd. (includes D.F. Smith)
☐ Petro-Canada Resources Ltd.
☐ Lochiel Exploration Ltd.
☐ Ranger Oil Ltd.
☐ Union Oil Co. of Canada Ltd.
Exploratory Wells (Shell - 1960's)
ALASKA
New Aiyansh
Kincolith
Port Simpson
Dundas I
Terrace
DIXON ENTRANCE
Prince Rupert
Masset
Kitimat
Kitamaat Village
Porcher I
GRAHAM I
Port Clements
Kitkatla
Kemano
BRITISH
Pitt I
Hartley Bay
Banks I
HECATE
Queen Charlotte
Skidegate
Sandspit
Butedale
Princess Royal I
COLUMBIA
Louise I
MORESBY I
Lyell I
STRAIT
Aristazabal I
Klemtu
PACIFIC
Ocean Falls
Bella Coola
Price I
King I
Waglisla
Kunghit I
Namu
OCEAN
QUEEN
Calvert I
CHARLOTTE
SOUND
0
100 Km
Current to Nov. 21, 1985
Port Hardy
Port McNeill
Alert Bay
VANCOUVER I

Figure 2: Areas Showing Rights to Exploration Licences

Since the mid-seventies, oil tankers have travelled off the British Columbia coast to and from Valdez, Alaska. Various measures have been adopted to reduce the risks of tanker traffic accidents in this region. These include distance-to-shore restrictions and an improved vessel management control system in the Strait of Juan de Fuca. It is the Panel's understanding that any adjustment to the moratorium on oil and gas exploration in the region would not affect or alter the existing restrictions on oil tanker traffic off the west coast.

THE FUTURE

Both Chevron and Petro-Canada have proposed only limited exploration programs for the present. If either proponent were to receive substantial encouragement from these programs, additional proposals for further seismic surveying and exploratory or delineation drilling would be forthcoming. Eventually, if the presence of a commercial oil accumulation were confirmed, proposals would be made to install fixed platforms, to undertake a development drilling program, and to transport oil and gas from these permanent platforms.

Chevron indicated that initial encouragement would extend its program through a third well. If the third well resulted in a discovery, after a period of evaluation, a four-well delineation program would begin. During early stages of this drilling, a detailed seismic survey would be conducted over the structure to broadly determine the area of the field and to select appropriate delineation and development drilling locations. The total delineation program would require one drilling rig on a continuous basis for approximately two-and-a-half years. Studies of probable production facilities would begin during the fifth year if the discovery were considered to be commercial. The time span between initial exploration and first production would be in the order of 10 to 15 years, even if early results were favourable.

The information provided by regulatory agencies concerning the time sequence of events associated with the development of petroleum resources in other areas confirms this scenario.

> *"I have no information concerning, no accurate information concerning plans of any other companies interested in this area. But, I think I should say that our experience elsewhere has been that when one company becomes interested, others seem to follow." (Bob Hornal, COGLA, Port Hardy, Sept. 1985)*

East side Skedans Island

3. REGIONAL SETTING

This section outlines the overall physical, biological, human and administrative setting in which the renewal of offshore hydrocarbon exploration would occur.

PHYSICAL ENVIRONMENT

SEAS

The waters where exploration is proposed lie mainly between the mainland and the Queen Charlotte Islands, and north of Vancouver Island to the Alaskan Panhandle. Also included are some coastal waters immediately west of the northern Queen Charlotte Islands.

Dixon Entrance, between the Alaska Panhandle and Graham Island, is an east-west trough about 70 km wide. Its depth ranges from 200 m in the east to about 400 m in the west, except for Learmonth Bank which rises to within 35 m of the sea surface where Dixon Entrance meets the Pacific Ocean.

Hecate Strait, between the Queen Charlotte Islands and the mainland, is 55 km wide in the north increasing to about 120 km off Cape St. James in the south. It is relatively shallow, having a submarine valley about 220 km long that hugs the mainland with a depth of 50 m in the north, increasing to 300 m in the south. The northwest side of the Strait next to Graham Island has a broad shoal of sands and gravels less than 100 m deep.

Queen Charlotte Sound, further to the south, is situated in the 170 km gap between Cape St. James at the southern tip of Moresby Island of the Queen Charlotte Islands and the Scott Islands off northern Vancouver Island. The submarine valley of eastern Hecate Strait extends southwestward through Queen Charlotte Sound as a broad trough and deepens to 400 m in the west. Further south are two more broad troughs that cut across the Sound with depths to 400 m.

Three major banks separate these troughs. Middle Bank is the deepest at 115 m and is situated mid Sound, east of Cape St. James. Goose Bank is the shallowest, is 31 m deep at its eastern edge, and is centred in the Sound. It is actively eroding with its sands being washed both north and south by bottom currents. Cook Bank, in the south, contains the Scott Islands at its southern edge and is a broad 70 m deep bank extending northwestward of Vancouver Island.

Off the west coast of Graham Island, the 200 m depth contour is about 30 km offshore. Further to the south, off Moresby Island's west coast, this distance shrinks to less than 5 km. Here, the depth plunges to over 2,500 m less than 30 km from the shore.

SHORES

The coasts in the region have different wave exposures, sediment types, backshores and geomorphological character. The outer coasts of the Queen Charlotte Islands have an extreme wave exposure, scarce sediments with few beaches, steep backshores, and resistant volcanic rocks. In contrast, the northern and east shores of Graham Island have abundant unconsolidated sediments which are being redistributed by waves and currents into a spit with wide sand and gravel beaches.

The southeastern coasts of the Queen Charlotte Islands and the mainland have wave exposures varying from very low in protected bays and channels to extremely high where they are exposed to Pacific Ocean swells. Backshores vary from resistant igneous rocks to coastal lowlands backed by mountains, occasional pebble and cobble beaches, and uplands cut by fjords, some with fjord-head deltas.

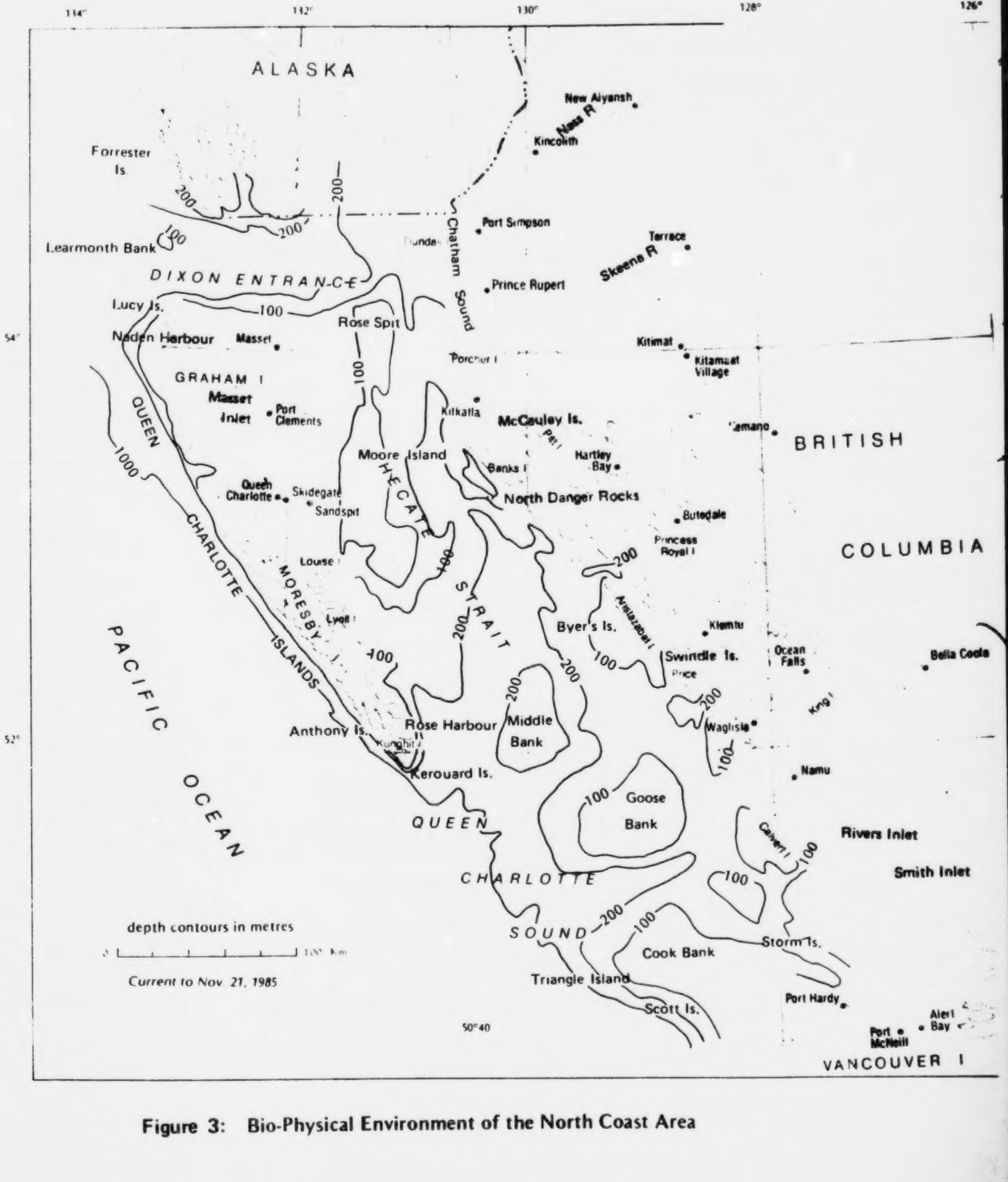
Where there are high energy waves, coupled with the high tidal ranges, often in excess of 7 m, all but the coarsest of coastal materials are moved into deep water or redistributed.

CLIMATE

The north coast of British Columbia has a temperate climate due to a prevailing onshore flow of marine air. The temperature of this air is regulated by the ocean with cool marine air from the northwest covering the coast in summer and warmer air moving onshore from the southwest in winter. Prevailing winds in the northeast Pacific depend on the location and intensity of two semi-permanent atmospheric pressure systems. The Aleutian Low, centred in the Gulf of Alaska, is dominant in winter, producing strong south-to-southeasterly winds along the coast. In summer, the North Pacific High predominates, producing north-to-northwesterly winds along the coast. These prevailing winds are interrupted for days or weeks by westward migrating high and low pressure systems which can produce intense storms.

Over the region's waters, mean daily temperatures in January are about 3°C, and about 12°C in July. However, there can be more than 20 days with frost in winter, with cold periods resulting from invasions of arctic air and Squamish winds through coastal inlets. Any vessel near a mainland inlet may experience superstructure icing from sea spray.

Annual rainfall in the region is about 1,550 mm (61 in), and snowfall adds about 50 mm (2 in). It is wettest during October, November and December. The region is subjected to overcast skies more than one-half the time over the entire year, often affecting visibility and flying


134°
132°
130°
128°
126°
54°
52°
50°40
ALASKA
Forrester Is.
200
200
200
100
Learmonth Bank
DIXON ENTRANCE
Lucy Is.
100
Rose Spit
Naden Harbour
Masset
100
GRAHAM I
Masset Inlet
Port Clements
QUEEN
1000
Queen Charlotte
Skidegate
Sandspit
CHARLOTTE
Louise I
MORESBY
Lyell I
ISLANDS
PACIFIC
OCEAN
100
Anthony Is.
Rose Harbour
Kunghit I
Kerouard Is.
QUEEN
CHARLOTTE
SOUND
Dundas I
Chatham Sound
Port Simpson
Prince Rupert
Porcher I
Kitkatla
Moore Island
HECATE
100
STRAIT
200
200
Middle Bank
New Aiyansh
Nass R
Kincolith
Terrace
Skeena R
Kitimat
Kitamaat Village
McCauley Is.
Pitt I
Hartley Bay
Banks I
North Danger Rocks
Kemano
BRITISH
COLUMBIA
Butedale
Princess Royal I
200
Aristazabal I
Byer's Is.
100
Klemtu
Swindle Is.
Price
200
Ocean Falls
Bella Coola
200
King I
Waglisla
100
Namu
100
Goose Bank
Calvert I
100
100
Rivers Inlet
Smith Inlet
200
100
Cook Bank
Storm Is.
Triangle Island
Scott Is.
Port Hardy
Port McNeill
Alert Bay
VANCOUVER I
0
100 Km

depth contours in metres

Current to Nov. 21, 1985

Figure 3: Bio-Physical Environment of the North Coast Area

conditions. Although common year round, fog is most prevalent in summer.

WINDS AND WAVES

The Queen Charlotte Islands lie in one of the windiest regions of Canada and severe winds are more common than in other areas; winds to 200 km/hr were estimated at Cape St. James in January 1951. Winds from major weather systems are modified by mountainous terrain and, within 50 km of coasts, tend to blow parallel to the shore. Strongest winds occur in December through February and weakest in July and August. Late September to early October is when abrupt increases occur in mean wind speeds. Strong winds occasionally blow in summer as well.

In Hecate Strait, the prevailing winds in winter are from the southeast, averaging 50 km/hr (27 knots) in January. In summer, prevailing winds are from the northwest and average 30 km/hr (16 knots) during July.

Prevailing wind patterns are modified by other factors. Strong winds flow out through inlets toward the sea when there is a high pressure system over the central or northern interior. These outflow or "Squamish" winds often reach gale force. Another modification, occurring mainly in summer, is caused by diurnal sea breezes set up by the daily heating and cooling of land masses near the sea.

Winds provide the energy for generating waves and swells. Both are highest in fall and winter when the strength, duration and fetch of winds are greater in comparison with summer conditions. Depending on the extent of sheltering by land masses and the direction of the swell, wave heights in Queen Charlotte Sound are generally less than in the Pacific Ocean. Also, average wave heights are less in Dixon Entrance than in Queen Charlotte Sound but higher than in Hecate Strait. Variations within these waterways depend on distance from the open ocean and on wind directions. Queen Charlotte Sound and the southern end of Hecate Strait are especially vulnerable to deep-sea waves and swell from the southwest.

Another effect of importance is the refraction and breaking of swell in gradually shoaling waters such as over the shallow banks in Queen Charlotte Sound and over Learmonth Bank in Dixon Entrance. Waves begin to steepen and amplify when they enter shallow water or face opposing currents. In addition, the period of such amplified waves can be shortened when they move against ebb currents.

A characteristic of the west coast is the suddenness with which extreme autumn wave conditions can arise. The Shell drill rig SEDCO 135F, situated in 137 m of water in Queen Charlotte Sound, was hit by a series of storms and heavy seas 9 to 15 m high for 16 days beginning in mid October 1968. On October 23, waves exceeding 20 m high occurred with a wave 30 m high being observed. The most dangerous aspect of the storm was not the maximum wave height but the rapidity with which wave heights increased. Within eight hours, the wave height had increased from 3 m to over 20 m. The more recent, serious storm on October 11 and 12, 1984, in which a number of fishermen lost their lives, has reinforced awareness of this hazard and the need for upgrading the prediction of storms.

> *"... we are in a region where severe storms can develop rather rapidly, where wave heights can become very significant within relatively short periods of time, and where wind speeds can be excessive." (Pat Haines, Chevron, Port Hardy, Sept. 1985)*

> *"... our waters rank with, or even exceed the worst in the world, including the Cape of Good Hope. Our waters are so dangerous, I am told, because combinations of factors arising from high winds, strong tides, shallow depths and giant waves can readily combine to produce extremely hazardous and freak conditions." (Jack Miller, Port Clements, November 1984)*

TIDES AND CURRENTS

Local sea level changes, caused by tides, occur roughly twice per day and generate tidal currents that move vast volumes of water. The mean tidal range is about 3 m at the seaward side of Queen Charlotte Sound. It increases to 4.8 m midway up Hecate Strait, further increasing to 5.0 m at Prince Rupert. From Prince Rupert to the seaward exit of Dixon Entrance, it decreases to 3.5 m. Tidal ranges over 7 m are found near Prince Rupert and within Skidegate Channel that separates Graham and Moresby Islands.

Currents are the sum of tidal currents and non-tidal currents, both of which contribute to the circulation of the region's waters. The non-tidal circulation is mainly a result of coastal winds and runoff from the land.

The tidal currents, themselves, are a combination of mainly diurnal and semi-diurnal components, but variations occur over periods of a fortnight, a month and a season. Where currents are confined by the topography of a channel, tidal currents ebb and flood aligned with the channel. However, where they have more sea-room, the tidal currents rotate over time. Where semi-diurnal tides dominate, as in the exploration region, a boat with a bow anchor would turn through a complete circle in one-half day. Tidal current speeds are generally in the range of 25 to 50 cm/sec (0.5 to 1 knot). Especially strong tidal currents occur in restricted waterways. Tidal current speeds off Cape St. James normally exceed 50 cm/sec (1 knot). Tidal streams in Hecate Strait show little rotation due to its valley-like shape and ebb and flood with rates up to 50 cm/sec (1 knot).

In Dixon Entrance, flood streams are stronger on the southern side and ebb streams stronger on the northern side. This creates a counter clockwise vortex or gyre in the centre of Dixon Entrance north of Rose Spit on northeast Graham Island. At the shore, tidal currents at the periphery of this vortex reach speeds between 50 and 100 cm/sec (1 to 2 knots). Local residents claim that these tidal currents can be in excess of 100 cm/sec.

Throughout the main waterways of the region, near-bottom tidal currents are weaker than at the surface, with speeds ranging between 15 to 25 cm/sec (0.3 to 0.5 knot).

Winds greatly influence current patterns. For example, with north to northwest prevailing winds, surface waters are driven southerly and southeasterly, parallel to the coast, at a few percent of the wind speed. A reversal will occur with south to southeast prevailing winds. These changes, superimposed on tidal fluctuations, will occur simultaneously over distances of hundreds of kilometres.

Runoff also affects current patterns, particularly during early summer following snow melt in the mountains. For example, brackish water, mainly from Nass and Skeena River runoff, hugs the northern side of Dixon Entrance as it flows westward at the surface; a compensating eastward flow of salt water tends to move along its southern side. The seaward motion of fresh water and its mixing with salt water also results in a landward underflow of salt water to compensate for the salt water lost in mixing. Runoff effects essentially disappear during November through February when runoff is minimal.

While wind and runoff are clearly important in generating currents, the response of the ocean to wind forcing can vary considerably throughout the north coast area. This response will depend on such local conditions as bathymetric features and proximity to fresh water runoff. Computations of the non-tidal component of near surface currents, that are derived as a fixed percentage of the local wind speed, provide only a rough guide to the actual current that could be encountered.

The surface waters of the region are often dominated by intermittent wind-generated inertial currents. These currents rotate clockwise (looking downward) and trace out a roughly circular path in 15½ hours (at latitude 51°N). They are often generated by the rapid passage of southeasterly frontal winds that accompany extra-tropical storms as they cross the north coast. Inertial currents may exceed 50 cm/sec (1 knot), and are mainly confined to the upper 50 m. They tend to persist for about 2½ days following the rapid passage of a storm but will decay more rapidly in shallow water where frictional effects occur. The interval between successive storms in the northeast Pacific in winter is about 2½ days, which suggests that extended periods of intense inertial oscillations will exist in the region from late autumn to early spring.

Surface currents are so complex that, while clearly more studies are required, it should not be assumed that a simple pattern will emerge that will significantly enhance predictive ability.

EARTHQUAKES

Earthquakes are common in the offshore and coastal regions of British Columbia. The region is one of the most active seismic areas of Canada. In 1949 the largest earthquake recorded in Canada occurred west of the Queen Charlotte Islands with a magnitude of 8.1 on the Richter scale. This earthquake occurred along an active major crustal plate fault, the Queen Charlotte Fault, which lies at the shelf-break just west of the Queen Charlotte Islands. Two other major earthquakes, both of magnitude 7.0, occurred in 1929 and in 1970 and are thought to have originated in this fault. Numerous lesser earthquakes have occurred in the complex fault system seaward of Queen Charlotte Sound. Several other more minor faults have been identified cutting through Moresby and Graham Islands, but their seaward extension into Queen Charlotte Sound and Dixon Entrance is uncertain.

Tsunamis, commonly although incorrectly called "tidal waves", are usually generated by subsea earthquakes. These are seismic sea waves with a wave length in the deep sea of several hundred kilometres but an amplitude of usually less than 1 metre. As they approach shallow or constricted waters, the wave length shortens and the wave amplitude increases. This effect is accentuated in shallow bays or estuaries where wave amplitudes reach tens of metres and destruction ensues. Offshore, ships or drilling platforms would seldom notice the passage of such a wave.

Other hazards associated with earthquakes are the possibility of drilling in a major active fault zone, and the creation of bottom sediment slumps and turbidity flows.

The latter occur when sediments on a slope are disturbed and flow in a high speed slurry on the seabottom. Such flows from the Grand Banks earthquake in 1929 severed submarine cables on the sea floor.

BIOLOGICAL ENVIRONMENT

ECOSYSTEMS

There are two major marine ecosystems in the region : the nearshore and the continental shelf. Nearshore ecosystems occur near rocky shores, on mud flats, in estuaries and in shallow bays. Sunlight penetrates throughout nearshore ecosystems and nutrients flowing through them from the sea are supplemented by those from the land. In shallow bays, estuaries and mudflats, nutrients regenerated from decaying organic matter are important to productivity. Water movement distributes some of the nearshore production into deeper water in the form of drifting detritus and rafts of seaweed, which contributes to pelagic and benthic foodwebs. In turn, the larvae and juveniles of fish such as salmon and herring depend on this production for survival.

Continental shelf ecosystems exist where deeper water prevents sufficient light from penetrating far enough for plants to grow on the seabottom but where the water is shallow enough so that production in the surface waters is directly accessible to the benthic community. The animals in benthic and pelagic communities interact directly. For example, sandlance migrate to shallow waters diurnally to feed on plankton, thereby transferring organic matter to the benthic community. Such shelf seas are also shallow enough so that currents and winds can mix the waters to make nutrients available to all parts of the foodweb.

In contrast to the nearshore ecosystems where seaweeds and seagrasses are primary producers, phytoplankton are the primary producers in continental shelf ecosystems. The growing season for phytoplankton in Queen Charlotte Sound and Hecate Strait is from April or May through to October. There is a spring bloom which falls off in summer, and then increases again in the fall. In summer, lower productivity results from depleted nutrients in stratified water. There is some evidence that mixing at oceanographic fronts creates enhanced productivity of phytoplankton, however, identification of such areas in the exploration region has yet to take place.

Both nearshore and continental shelf ecosystems have grazers and scavengers. Grazers such as zooplankton, snails, clams, chitons and urchins consume phytoplankton and seaweeds. Grazers, in turn, are eaten by starfish, predacious snails, salmon, herring, petrels, ancient murrelets and gray whales. Some of these are eaten by halibut, ling cod, cormorants, eagles, falcons, seals, dolphins and killer whales. Scavengers exist on the remains and excretions of other organisms. Typical of these are bacteria, sea cucumbers, anemones and shore crabs.

FISH

Shellfish and other invertebrates in the area include Dungeness crabs, razor clams, littleneck clams, butter clams, geoducks, weathervane scallops, mussels, abalone, octopus, squid and red sea urchins.

Finfish are a significant renewable marine resource in the region. Of these, the five species of Pacific salmon -- chum, coho, chinook, pink and sockeye — are the most important. About 650 rivers and streams in the region are used for spawning and by juveniles. Large runs of salmon occur in the Bella Coola River, Skeena River, Nass River, Smith Inlet, Rivers Inlet and elsewhere. Also, salmon stocks from Alaska, Washington, Oregon and California migrate through the region's waters to and from the Gulf of Alaska and the north Pacific. Immature salmon may spend several months feeding in estuaries while gradually becoming adjusted to salt water before moving offshore. More than 1 billion fry are believed to migrate up the coast. Information on the timing and paths of juvenile migrations is uncertain, but it is suspected that most migrate close to the shore within the upper 10 m of the water column.

Adult Pacific herring migrate to their spawning grounds, mostly during March and April, and they spawn in inshore protected waters. Eggs are deposited on kelp, red algae, eelgrass and rockweed where they hatch after 10 to 20 days. After hatching, larvae congregate in large masses near the spawning grounds. Adult herring are an important food for salmon, groundfish, some seabirds and marine mammals.

Groundfish are bottom dwelling fish that inhabit deeper offshore waters as adults and include species within the flatfish, rockfish, greenling, sablefish, cod, skate and dogfish families. Although most are demersal for a large proportion of their adult lives, all groundfish have pelagic larval stages and many produce pelagic eggs.

Species of flatfish within the region are Pacific halibut, dover sole, rock sole, turbot and petrale sole. Most soles and flounders spawn in winter and early spring; generally, most eggs are pelagic, some floating below the surface. All their larvae are pelagic.

Thirty-three species of rockfish occur in the region. Eight species of greenling and two of sablefish are known in these waters. Ocean perch, rockfish, ling cod and sablefish are the most numerous groundfish in Queen Charlotte Sound. All four species of true cods occur in the region. Cod spawn in winter and spring, most producing pelagic eggs.

Also of importance within the region is the eulichan. The total spawning stock in the Nass River alone is estimated to be 1,000 tonnes. Eulichon larvae, juveniles and adults appear to have a wide ocean distribution and are likely to be abundant in Hecate Strait and Dixon Entrance. Information on this species is sparse.

The eggs and larvae of various fish species are vital and vulnerable stages in the life history of some fish but little is known about them. A recent, limited study indicates that their abundance varies within the region and with the time of year. It also indicates that sandlance larvae are predominant and thus are likely to be of major importance to pelagic foodwebs. They are known to be a main diet item for some seabirds, both as larvae and adults.

BIRDS

Millions of breeding, migrating and marine birds use the waters off the north coast of British Columbia. Most common are the true seabirds: albatrosses, shearwaters, fulmars, storm petrels, cormorants, gulls and alcids. Shorebirds are also numerous. At times, other birds such as loons, grebes, swans, ducks and geese often outnumber seabirds in some coastal areas, particularly outside the breeding season.

The birds of the coast feed at all levels of the foodweb. Canada geese, brant and dabbling ducks feed on vegetation; some grebes, some diving ducks, some alcids and shearwaters feed on crustaceans, euphausids and amphipods; black turnstones, oystercatchers, surfbirds and other shorebirds eat intertidal invertebrates. Diving ducks eat molluscs, especially mussels and some herring roe and marine vegetation; shearwaters eat cephalopods; loons, grebes, cormorants, mergansers, some alcids and gulls eat fish, including herring and sandlance.

By far the greatest proportion of colonial breeding seabirds on the west coast are alcids, including guillemots, murres, puffins, auklets and murrelets. They live almost exclusively at sea and come ashore only long enough to breed and launch their chicks into the sea. They require only small territories for their nests or burrows and most breed in high density colonies, located on exposed, isolated islands or points on or near the Queen Charlotte Islands, Vancouver Island or the mainland. The marbled murrelet is an exception. It nests in coastal forests and in rocky screes are believed to be scattered along the length of the entire coast.

Major seabird colonies in the area are:

—Triangle Island in the Scott Islands has the largest number of breeding seabirds on Canada's west coast, approximately three-quarters of a million. This includes about 360,000 pairs of breeding Cassin's auklets, representing 40 percent of the world's breeding population. There are also large colonies of rhinoceros auklet and tufted puffin, the latter being the largest colony on Canada's west coast.

—On the east coast of Moresby Island are a series of nesting areas for storm petrels, Cassin's auklets and ancient murrelets. At the present time, a large colony of ancient murrelets is located on Lyell Island.

—On Moresby Island, Cassin's auklets nest at Kerouard and Anthony Islands. Engelfield Bay has an important storm petrel colony.

—Along the west coast of Graham Island are major nesting sites for Cassin's auklets, ancient murrelets and storm petrels.

—In Queen Charlotte Strait, large colonies of rhinoceros auklet occur on Storm Island and Pine Island. As well, storm petrels nest on Tree Island and in the Buckle Group.

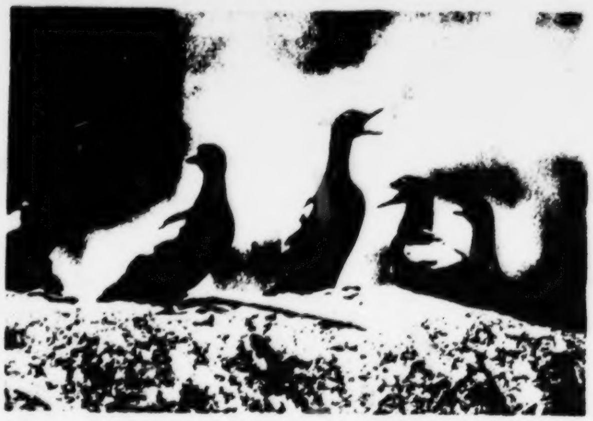
—Off the northern mainland coast, Lucy Island in Chatham Sound has a large colony of rhinoceros auklets; Moore Island has a large colony of Leach's storm petrels; and Byer's Island has a large colony of ancient murrelets.

—The Forrester Island group in the Alaskan waters of northern Dixon Entrance has large colonies of storm petrel, murrelet, auklet and puffin totalling more than one-half million breeding pairs of birds.

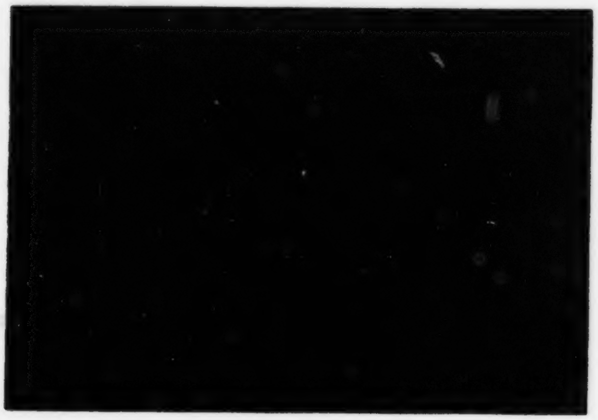
In addition to colonial breeding seabirds, migrants and overwintering birds use the marine waters of the region. Over a million birds heading for northern Canada and Alaska use the coastal waters in the spring and on return in the fall. Shearwaters are southern hemisphere migrants that occur in spectacular numbers primarily from April through October. Other common migrants are: arctic loons, phalaropes, geese, swans, ducks and gulls. Most migrants concentrate in protected estuaries and bays and use particular offshore feeding areas from November to April.

Shore-associated species such as oystercatchers, bald eagles, peregrine falcons, great blue herons, kingfishers and northwestern crows are, for the most part, permanent residents, although specific populations may be migratory.

Existing information provides a general picture of seabird use of the region. However, much is still unknown and scientific confirmation of this "general picture" proceeds slowly. For example, an accurate population census of the major colonies is far from complete. The colonies of the mainland coast are poorly known as is the feeding ecology of offshore seabirds.



Pigeon Guillemot



Canada Geese at Masset

MAMMALS

There are 29 species of marine and marine associated mammals in the region that use offshore and nearshore waters and shorelines. Only seven or eight of the 29 species are commonly seen. These include whales, porpoises, dolphins, seals, sea lions, otter and mink. The number of seals and sea lions are relatively well known because they haulout on land. The numbers of other species are less known with the exception of gray whales, which are now the most numerous of the large whales frequenting the region. About 12,000 migrate northward every spring, mostly during April and May, and then return southward mostly during November and December. They normally travel two to four kilometres offshore in Hecate Strait and in Dixon Entrance. Unlike most other baleen whales, they are bottom feeders and sift benthic organisms from mouthfuls of sediment close to shore. Most do not feed in British Columbia waters, but some are thought to terminate their northward migration in the region and are often seen in Hecate Strait in summer.

Commercial whaling ceased off Canada's west coast in 1967, however, at Rose Harbour between 1926 and 1943, 2,000 whales were processed including sperm, blue, fin, sei and humpback whales. Today, other than gray whales, minke whales are the most commonly seen. Other cetacea commonly seen are Pacific striped dolphins, Dall porpoises, harbour porpoises and killer whales.

Common Murre

Fur Sea Haulout

Stellar sea lions and Pacific harbour seals are common coastal residents in the region. Harbour seals breed over their entire range. Pups are born in May and June, mainly in the Skeena River estuary. Steller sea lions breed only at three rookeries: one on the Scott Islands off the northern tip of Vancouver Island; one on Kerouard Island at the southern tip of the Queen Charlotte Islands; and another on North Danger Rocks west of Banks Island in Hecate Strait. The young are born during the summer. After breeding, the bulls disperse to favoured haulouts along the west coast of Vancouver Island, the Queen Charlotte Islands and the nearby mainland.

Most northern fur seals (about 1,650,000 animals) migrate well offshore, northward in late March to mid-May and southward beginning in December. Yearlings, appearing in December, winter in Hecate Strait, Queen Charlotte Sound and in various inside channels along with small numbers of two to three year old males.

River otters, adapted to salt water on the west coast, are scattered throughout all coastlines in the region. Mink, though not present in the Queen Charlotte Islands, are generally scattered along all shorelines of the west coast. They feed mostly on marine organisms, especially crabs.

Other common land mammals frequenting the shores are deer and the Queen Charlotte Island black bear.

COMMERCIAL AND SPORT FISHERIES

COMMERCIAL FISHERY

The commercial fishery in British Columbia provides employment, income and a way of life for many British Columbians. Approximately 17,500 fishermen and 6,000 associated shoreworkers are employed directly with an equal number of persons employed in jobs servicing and supplying the industry. Salmon is the most important fishery representing 60% of the landed volume. Also important and making up the balance are herring, halibut, groundfish and shellfish. Commercial harvests in some years have resulted in wholesale values of up to $500 million and growth in this value is anticipated with rapidly developing mariculture and salmon enhancement projects.

Hecate Strait, Queen Charlotte Sound and Dixon Entrance are extremely important to the commercial fishery and can account for over 50% of the landed value of all fishery products. In addition, these areas are migration corridor for great numbers of juvenile and adult salmon migrating to or from Washington State, Oregon State, southern British Columbia, northern British Columbia and Alaska. Hundreds of millions of Canadian juvenile salmon, and possibly even more American salmon, migrate through this area.

> *"With the coming of the Europeans, fishing expanded into commercial fisheries, and now we have commercial fisheries, sports fisheries, native food fishery, and not only is it important to the culture of the native people, the livelihood of the native people, but the livelihood of the fishing industry and the economy of British Columbia." (Anja Streich, Waglisla, November 1984)*

Salmon

Five species of Pacific Salmon are harvested in the study area and quantities in any year vary depending on their life-cycle of two to six years, and survival rates in fresh and salt water. There are approximately 650 significant salmon streams adjacent to the study area. Most rivers support more than one species and some rivers support all species of salmon.

Salmon are caught by seine net, gillnet or troll. Seine and gillnet fishing takes place along inside passages and in inlets and estuaries close to spawning rivers. Salmon trolling takes place mostly offshore and along the continental shelf and banks. Salmon fishing normally commences in April and extends into November. Peak periods occur in mid-summer.

Salmon processing involves either canning, freezing or curing and is highly labour intensive. Ninety percent of salmon are processed at either Prince Rupert or Vancouver, with the balance processed at Masset, Port Simpson, Bella Bella, Port Hardy and Victoria.

> *"Salmon is B.C.'s most important fisheries resource, and it represents approximately 60 per cent of total landed value and 64 per cent of total wholesale value of all B.C. fish production. The preliminary figures for 1985, the landed values are estimated to be somewhere between $190 to $200 million, with the wholesale value of salmon alone exceeding $350 million. Some of the wholesale values of the other species, for example roe herring, average approximately $100 million annually. For halibut, $11 million annually. For groundfish species, and there are many species of groundfish harvested, $47 million...." (M. Burgess, Fisheries Council of B.C., Victoria, October 1985)*

Herring

Herring have always been an important part of the commercial fishery and on occasion their landed value has exceeded that of salmon. Before 1965, herring was used mainly for the manufacture of fish meal and oil; catches during this period averaged 165,000 tonnes per year. Due to several poor year classes and possibly overfishing, the fishery was closed in the mid-1960's to allow for the rebuilding of stocks.

The stocks recovered dramatically after a few short years and a small roe fishery was permitted in 1969. Because of its high economic value, this fishery quickly expanded and peaked in 1979 at more than $200 million. In recent years the resource has again become weak, and stringent conservation methods have again become necessary.

Roe herring are caught by both gillnet and seine and are harvested close to their spawning time and spawning location in order to ensure the highest possible roe recovery. A small portion of the catch is caught by seine and impounded to provide a "Roe on Kelp" product.

The majority of herring caught within the study area are processed in Prince Rupert and the operation is labour intensive.

Halibut

Pacific halibut have the highest economic value of the groundfish species. They are caught using a longliner hook and line primarily in Hecate Strait and Dixon Entrance. The fishery normally takes place in short periods from May to August.

Due to overfishing and poor survival of certain year classes, halibut stocks declined seriously during the 1960's, and strict conservation measures had to be adopted. Recently, stocks have been rebuilding and quotas for the fishery are being increased.

Because of their transboundary migrations, halibut are managed by the joint United States and Canadian International Pacific Halibut Commission.

Groundfish

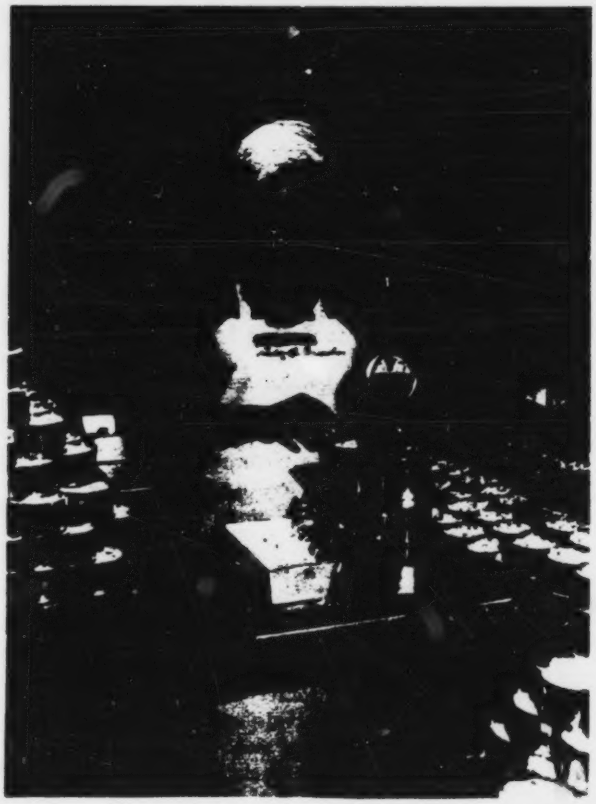
Cod, perch, sole, flounder, pollock and other groundfish abound in the study area and are caught by either bottom or mid-water trawl. Fishing takes place primarily offshore. The fish are landed in both Prince Rupert and Vancouver. Normally the fishery takes place during all months of the year.

Shellfish

Shellfish such as prawns and crabs are caught in traps, shrimp are trawled, abalone and geoducks are harvested by divers and clams are dug by hand or machine at low water.

SPORT FISHING

Sport fishing in British Columbia is an important recreational activity for over 300,000 residents and visitors, and a substantial economic resource. Economic activity generated by the recreational fisheries include boat gear and moorage purchases and rentals, tourist facilities and guiding services. Angler-owned pleasure boats alone were estimated to be worth $837 million in 1980. Spending related to marine sport fishing is presently estimated to exceed $100 million annually. As in the commercial fishery, salmon is by far the most important species, but others such as cod and shellfish have value. While most of the sport fishery in British Columbia occurs in the Strait of Georgia and the Strait of Juan de Fuca, a moderate



Crab Cannery at Masset

Sport Fishing at Rivers Inlet

amount, about 10%, occurs in the study area. This area also holds the greatest opportunity for growth.

MARICULTURE

The biophysical characteristics of the area favour mariculture development. Significant mariculture development could occur within the next five years in nearshore areas in the vicinity of Port Hardy, Prince Rupert, Sandspit, Bella Bella, southeast Moresby Island, and areas between McCauley and Swindle Island. Several native groups are interested in this activity.

> *"... there's a race between the people who would like to see mariculture developing here and its enormous growth potential shown, and those who see other potential industries here which are ultimately in direct conflict with mariculture ..." (Hans Elfert, Prince Rupert, November 1984)*

NATIVE FOOD FISHERY

The sea is an important source of food for the native people of the British Columbia north coast. Seafood is a valuable trading commodity and the focus of social activity. Economic development is based largely on the abundance of fish resources, particularly salmon, shellfish and eulichan.

The native food fishery includes a great variety of seafoods harvested annually and preserved for later use. This includes clams, abalone, eulichan, crab, mussels, cockles, scallops, seaweed, sea urchins, chitons, as well as salmon, halibut and herring.

In a study undertaken in Waglisla, all the respondents indicated an extensive use of traditional foods. It was difficult to quantify the amount used per family as the foods were shared among family members, however, it is generally accepted that a significant portion of their diet comes from local seafood. Nonetheless, this study highlighted the inherent importance of food gathering and its high social value.

Harvesting the food, and processing and preparing it, is almost as important as eating it. Learning how to catch fish, cut it up for smoking, gather herring eggs, dig clams, harvest seaweed, jig for ling cod or halibut, and process eulichan are all skills to be learned from members of the extended family. This is the very basis of the heathly and complex aboriginal society which exists in the region.

The relationship between salmon and the Indian people at the time the first explorers arrived has been described : "The fish determined where the people lived. No accurate figure can be given, but intelligent estimates of the aboriginal population of what is now British Columbia are set at approximately 80,000, an impressively high population density for native North America and about 40% of the total Native population of all Canada. The obvious reason for this concentration of people was the availability of food and that food was salmon. In the interior the people lived close to the rivers because they were highways through the forests as well as conveyors upon which their protein arrived. A population map would show the areas about the main salmon rivers shaded dark." (The Salmon People. Hugh W. McKervill, 1967)

> *"Us Haidas, we go out to the beach, take what we want, just like opening a door of a fridge." (Alfred Davidson, Masset, November 1984)*

> *"... How we live off the sea is something, some experience that even Her Majesty the Queen probably couldn't even eat as well as we can." (Frank Wesley, Port Simpson, November 1984)*

OTHER RESOURCE USES

A number of other important marine related resource use activities exist in the area and there is the potential to support expansion of these as well as to introduce new ones.

TOURISM AND RECREATION

Wilderness recreation on the west coast is among its fastest growing industries. South Moresby and the west coast of Graham Island are described as among the finest wilderness recreation areas in the world. The region has enjoyed significant increases in tourism and recreational use in recent years and these should continue with improved access and the availability of additional tourist facilities.

At present there are six provincial parks in the region and an additional five have been proposed. Improved visitor facilities are being developed at Port Hardy, Bella Coola, Prince Rupert, Masset and Queen Charlotte City. A number of tour operations are also active in the region.

Specific activities include scuba diving, kayaking, sailing, motor cruising, sightseeing from Alaska bound cruise ships and coastal ferries, sport fishing, hunting, whale watching, beachcombing, nature tours, hiking, camping, recreational vehicle use, cultural and anthropological tours, bird watching, wildlife viewing and photography.

> *"... it's a pristine coast, and it's reflected in the tourist trade that comes to visit this area, the appreciation that people from all parts of the world have for not only the beauty of the coast, but its unpolluted quality ... " (Paul Manson, Prince Rupert, November 1984)*

SENSITIVE AREAS

A number of coastal areas have been identified which are either unique or particularly sensitive to environmental damage. At present, fifteen areas have been designated as Ecological Reserves and eight others have been proposed. In addition, there are two Natural Areas of Canadian Significance and one wildlife sanctuary. All coastal islands with areas less than 64.75 hectares (160 acres) and north of 51°N latitude are currently reserved from alienation. There were a number of other areas identified as deserving of special protection.

The British Columbia Heritage Conservation Branch estimated that there are at least 2,000 shoreline archaeological sites in the region.

PORT AND SHIPPING ACTIVITIES

Prince Rupert is one of the largest natural harbours in the world and handles a significant and increasing volume of international shipping. Deep sea freighters such as cargo carriers, bulk container vessels and large passenger vessels put into Prince Rupert on a year-round basis. Freight traffic from the Ridley Island coal and grain terminals is expected to increase with proposals for further coal shipments. The shipment of LNG from the proposed terminal at nearby Port Simpson may also increase freight traffic. Kitimat, Stewart, Port Hardy and Port Alice also handle international traffic.

Coastal vessel traffic consists of tug and barge or boom combinations, self-propelled barges, ferries, coastal ships such as freighters, fish packers and tankers, commercial fishing vessels and recreational vessels. Many coastal communities and logging camps depend on marine transportation for supplies. Commercial fishing vessels are generally active from April through September. The density of vessels on the fishing ground, their fishing method, short-notice changes in fisheries openings and frequent periods of poor visibility create some unique marine traffic concerns.

A voluntary Vessel Traffic Management System is currently in place.

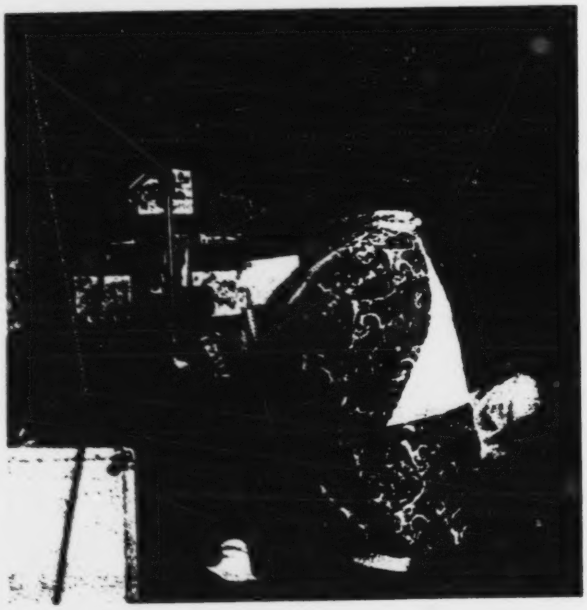
PEOPLE

The total population in the vicinity of the exploration area is 57,000 (Statistics Canada, 1981). The population is distributed among several larger centres: Prince Rupert (16,000), Kitimat (13,000) and Port Hardy (5,000) and a number of smaller communities. While most communities can be reached by water and air transportation, the larger centres are also linked by rail or road transportation. A number of communities are in close proximity to each other at the north end of Vancouver Island, on the Queen Charlotte Islands and in the Prince Rupert area, while communities on the rest of the mainland coast are few and relatively far apart.

The aboriginal population of the area is about 10,000 or 18% of the total population. About two-thirds live on Indian Reserves. The resident on-reserve population for individual bands may represent as little as one-third of those who consider that reserve as their home community.

The economic base of the region's population has been highly dependent on renewable resource-related activities since before the turn of the century. Many communities in the north coast region of British Columbia depend primarily upon fishing and forestry resource industries, except for Port Hardy which also depends on mining, and Kitimat which is based on mineral processing.

In many cases, however, the economic base of individual communities is based almost exclusively on a single activity such as fishing, as in Waglisla, Port Simpson, Alert Bay and Sointula; or forestry as in Port Clements and Sandspit. This leaves these communities extremely vulnerable to shifting markets. Employment in the fishery, fish processing and forestry industries is highly seasonal and workers often earn their entire year's income in a relatively short period of time. In particular, employment in fishing is volatile. The weight and value of the catch can fluctuate widely from year to year. Consequently, many communities have sought opportunities to diversify their economic base through tourism, fish processing and mariculture.



"When we speak about this issue, we are speaking from our hearts, for it's because of our love for this part of the coast that we are here." (Lynn Hill, Hartley Bay Band Council, Hartley Bay, September 1985)

ADMINISTRATION

LOCAL AND REGIONAL GOVERNMENTS

Community governments on the British Columbia north coast are organized under the British Columbia Municipal Act or the federal Indian Act. In addition, regional districts are established under the Municipal Act. These include the four regional districts of Skeena-Queen Charlotte, Kitimat-Stikine, Central Coast and Mount Waddington. Regional districts provide a federated approach to local control over problems which extend beyond municipal boundaries.

Within the review area are a number of incorporated municipalities including the city of Prince Rupert, four district municipalities, one town and seven villages as well as numerous unincorporated communities. Incorporated municipalities are responsible for providing and managing community services such as water supply and sewage disposal. In the case of unincorporated communities, it is the regional district or an improvement district that is responsible for these services. None of these communities have the authority to become directly involved in the management of oil and gas developments offshore.

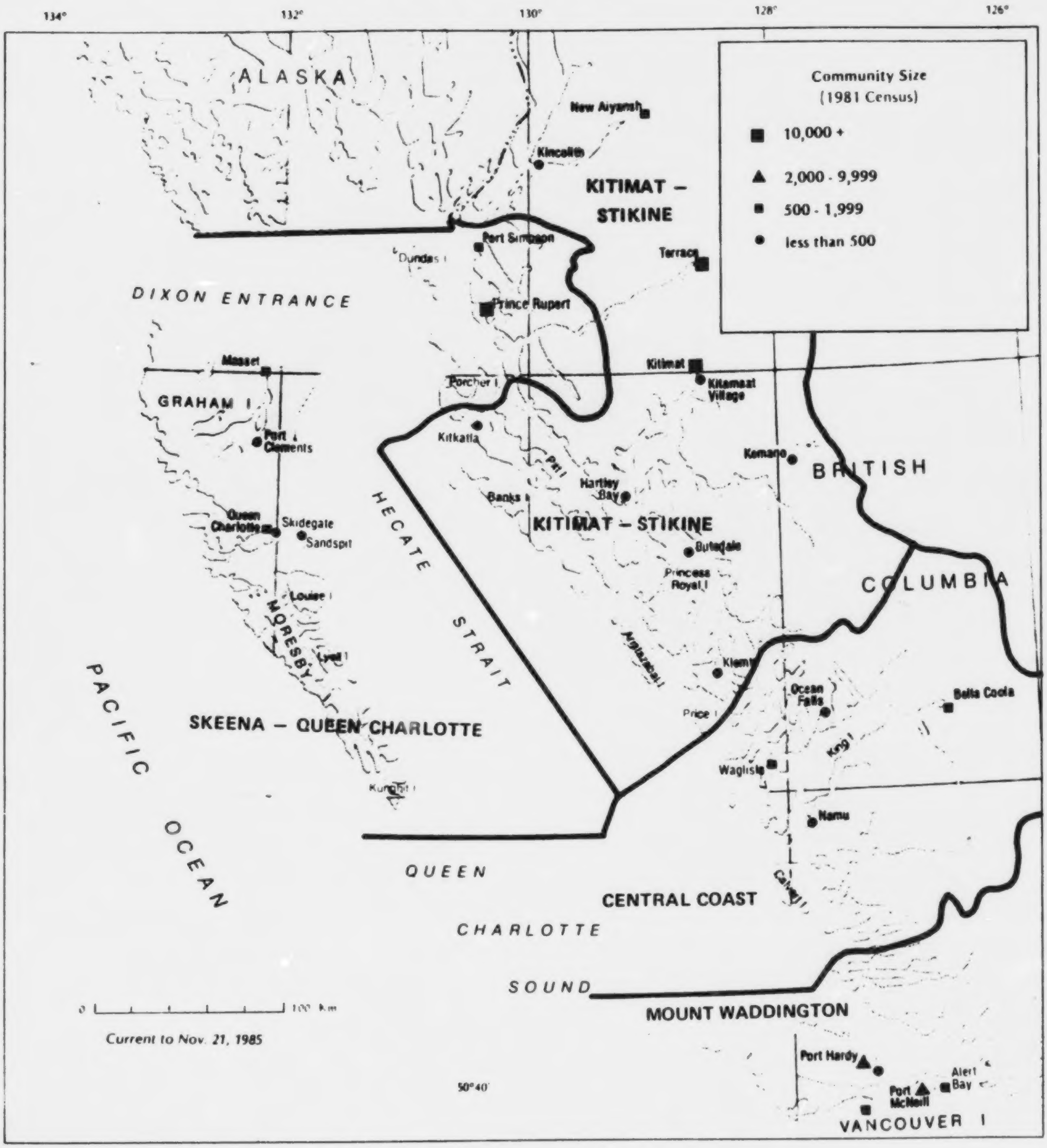
Native communities administered by Indian bands are organized under the Indian Act. Bands have varied mandates, varied authority to manage community services, and varied financial resources available to them. Decisions are subject to approval from the Department of Indian Affairs and Northern Development. Indian bands having a similar interest or concern may unite to form tribal councils. Tribal councils create a forum to represent issues of common interest and to lobby the provincial and federal governments.

Tribal councils or bands with similar concerns have formed larger alliances, such as the Offshore Alliance of Aboriginal Nations, in order to provide representation on issues of mutual concern.

These various Indian organizations have no authority at present to become directly involved in decisions surrounding the protection and conservation of marine resources. However, representatives of native groups often become involved in resource use issues indirectly through informal consultations. Participation usually occurs through the initiative of the individual band or tribal council.

ADMINISTRATION OF OFFSHORE PETROLEUM RESOURCES

A number of federal and provincial agencies are responsible for resource management and regulation in the exploration area. The Canada Oil and Gas Lands Administration of the federal government, and the Ministry of Energy, Mines and Petroleum Resources of the provincial government are responsible for regulating and managing offshore petroleum resources. Current administrative arrangements are described in the boxes.


134°
132°
130°
128°
126°
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ALASKA
New Aiyansh
Kincolith
KITIMAT – STIKINE
Port Simpson
Dundas I
Terrace
Prince Rupert
DIXON ENTRANCE
Masset
GRAHAM I
Porcher I
Kitimat
Kitamaat Village
Port Clements
Kitkatla
Kemano
BRITISH COLUMBIA
Pitt I
Hartley Bay
Banks I
HECATE STRAIT
KITIMAT – STIKINE
Queen Charlotte
Skidegate
Sandspit
Butedale
Princess Royal I
Louise I
MORESBY I
Lyell I
Aristazabal I
Klemtu
PACIFIC OCEAN
Ocean Falls
Bella Coola
SKEENA – QUEEN CHARLOTTE
Price I
King I
Waglisla
Kunghit I
Namu
QUEEN CHARLOTTE SOUND
Calvert I
CENTRAL COAST
MOUNT WADDINGTON
0 100 Km
Current to Nov. 21, 1985
Port Hardy
Port McNeill
Alert Bay
VANCOUVER I
Community Size (1981 Census)
■ 10,000 +
▲ 2,000 - 9,999
■ 500 - 1,999
● less than 500

Figure 4: Regional Districts and Communities

CANADA OIL AND GAS LANDS ADMINISTRATION

The Canada Oil and Gas Lands Administration is responsible for ensuring that industry complies with the statutory and administrative requirements of federal government agencies. This coordinating role is particularly important in the administration of environmental management matters in offshore areas since a number of federal government agencies such as the Department of Fisheries and Oceans, Environment Canada, and the Canadian Coast Guard, as well as several provincial ministries, all have key regulatory and advisory roles.

A major function of the Canada Oil and Gas Lands Administration is to assess the identifiable impacts of oil and gas activities upon the natural and human environments. It assesses proposed offshore activities on the basis of available information and expert advice from both internal staff and interagency advisory bodies. It may disallow the activity, permit the activity as proposed, or permit it subject to modifications designed to protect the environment.

The Canada Oil and Gas Lands Administration operates under the authority of the Canada Oil and Gas Act, the Canada Oil and Gas Production and Conservation Act and their allied regulations.

The Canada Oil and Gas Act provides the basis for granting exploration, development and production rights as well as defining how the benefits from offshore production will be distributed between government and industry. This Act allows the Governor-in-Council to withdraw lands from exploration for any reason, including "an environmental or social problem of a serious nature" (Section 6(b)). Revisions to this Act are currently before parliament.

The Environmental Studies Revolving Fund

The Canada Oil and Gas Act provides the authority to establish an Environmental Studies Revolving Fund for the purpose of financing environmental or social studies, to help Ministers "decide whether or not to authorize exploration or development activities under this Act or any other Act of Parliament" (Section 49). Oil and gas companies holding acreage in various regions throughout Canada Lands contribute to this fund through a levy system. Research carried out under this fund is administered by the Canada Oil and Gas Lands Administration upon the advice of working committees which include representatives of various government departments and industry. Money from the fund has already been used extensively in studies related to east coast and Arctic offshore oil and gas activities, but few studies have been conducted to date on the west coast because of the moratorium.

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

The Ministry of Energy, Mines and Petroleum Resources is the provincial agency responsible for the regulation of petroleum exploration and development and the administration of provincial oil and gas rights within British Columbia. The Petroleum Resources Division within this Ministry authorizes exploration, drilling and production operations under conditions set out in the British Columbia Petroleum and Natural Gas Act.

The Petroleum and Natural Gas Act regulates the disposition of petroleum and natural gas rights in the province, effects the conservation of the oil and gas resources of the province, secures the observance of safe and efficient field practices, and affords each owner of oil and gas reserves the opportunity to obtain its share of production. Petroleum activities are also to be carried out in general cooperation with the needs of local residents in all areas of British Columbia where petroleum potential exists. The Petroleum Resources Division has prepared Draft Regulations pertaining to offshore oil and gas activities. These are compatible with those used by the Canada Oil and Gas Lands Administration in other offshore regions in Canada.

The Ministry of Energy, Mines and Petroleum Resources solicits advice from the Ministry of Environment and others on all environmental management issues pertaining to offshore hydrocarbon activity and is committed to developing and establishing any resulting terms and conditions for project developments accordingly.

Regulations

Regulations derived from the Canada Oil and Gas Production and Conservation Act provide the ability for government to manage activities associated with offshore operations and contain provisions for the environmental safety of these operations. Regulations include the Canada Oil and Gas Drilling Regulations. Among other things, they require the identification of natural conditions that might affect the safety of the operation, such as weather, sea conditions and ice hazards. They also require an assessment of the natural environment that might be affected by oil and gas activity.

Exploration Agreements

The Exploration Agreements entered into with the Canada Oil and Gas Lands Administration give an interested company the right to explore for hydrocarbons on specified Canada Lands over a specified period of time, usually five years. In exchange for these rights, the company must agree to evaluate the oil and gas potential on the area covered in the Agreement. This evaluation requirement is also defined in the Agreement but usually consists of a comprehensive seismic survey and the drilling of one or more exploratory wells.

The Exploration Agreement generally does not contain provisions that relate directly to environmental management. However, in cases where information on social or environmental resources at risk is determined to be inadequate for decision-making purposes, the Exploration Agreement may require the operator to conduct certain environmental studies or to undertake a consultative process with community interests such as the fishing industry or native people, before proceeding with exploration activities. Where exploratory activities will be conducted in hostile physical environments, the Agreement may restrict the times of year during which a company is permitted to operate.

Other Government Management Agencies

Other federal and provincial agencies have responsibilities for managing resources which could be affected by resource development off the British Columbia coast. For example, the federal Department of Fisheries and Oceans manages the fisheries resource in the area. Certain aspects of this are transferred by agreement to the Fisheries Branch of the British Columbia Ministry of Environment. Other regulatory or management agencies actively involved in the region include the Canadian Coast Guard, Environment Canada, the Department of Indian Affairs and Northern Development, the British Columbia Ministry of Lands, Parks and Housing, the British Columbia Ministry of Municipal Affairs, other branches of the British Columbia Ministry of Environment and the British Columbia Ministry of the Provincial Secretary (Provincial Museum, Heritage Conservation Branch).

Skidegate

4. ISSUES AND KEY RECOMMENDATIONS

During the Panel's review, a number of key issues emerged which established the base for its analysis. The Panel's detailed recommendations, including terms and conditions to be applied to offshore exploration, are derived from consideration of these key issues.

These key issues are:

- environmental risk of offshore hydrocarbon exploration;
- public involvement in the management of offshore hydrocarbon exploration;
- aboriginal concerns;
- compensation; and
- research.

ENVIRONMENTAL RISK OF OFFSHORE HYDROCARBON EXPLORATION

There is no doubt that marine hydrocarbon exploration activities, regardless of how well they are planned, will have some potential to seriously affect the health of the marine environment. A major focus of this review was to ensure that those activities which may take place will be well planned, controlled and managed to provide maximum protection to the marine environment. Regardless of such planning, control and management, there will nearly always exist threats to the environment, possibly wide-ranging and long-term, that cannot be prevented or mitigated to a reasonable degree. Hence, the question is raised regarding the acceptability of such threats and, therefore, the acceptability of the risks associated with offshore hydrocarbon exploration off the north coast.

However, acceptability is a subjective judgement. It is often influenced as much by proximity to a perceived threat, as it is by the potential magnitude of that threat. In considering the acceptability of the environmental risk of offshore hydrocarbon exploration off the north coast, the Panel has examined the nature of such threats from the standpoint of the sources of threats, the likelihood of their occurrence, the effectiveness of remedial or preventative measures, the potential for significant environmental damage, and the potential for recovery from such damage, both natural and with human intervention.

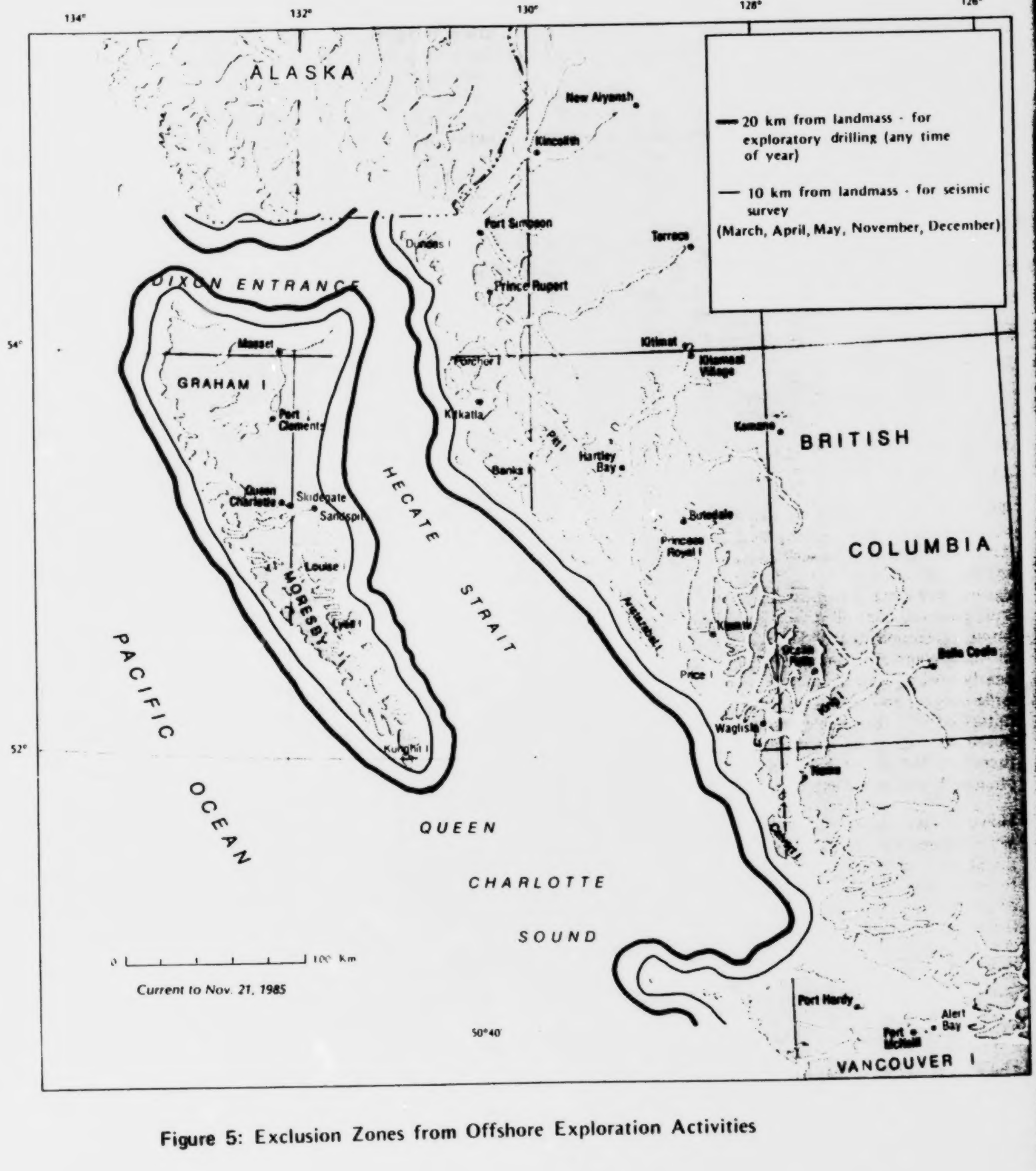
The Panel concludes that the environmental acceptability of the risks associated with offshore hydrocarbon exploration off the north coast most directly relates to the possibility of a major oil blowout from which a large quantity of oil is discharged into the marine environment.

Much of the discussion during the hearings involved attempts to establish levels of risk. Risk, in turn, is determined by two factors, probability of occurrence and vulnerability of resources exposed. Vulnerability of exposed resources is determined by their proximity to the threat and, for living organisms, by their sensitivity to impact through various stages of their life cycles.

Considerable effort was made during the hearings to quantify the probability of an oil blowout. Probabilities based upon an analysis of statistics are inevitably misleading and, in the final analysis, unhelpful. The only conclusion that can be drawn from this type of analysis is that while the likelihood of a major offshore oil blowout is very small, it will always be present.

The number of worldwide offshore blowouts have been few, and information about them is limited and varies in quality. However, it is clear from an analysis of the causes of past blowouts that the likelihood of occurrence of a well blowout is most dependent upon the experience and training of drilling personnel, quality of equipment, physical operating conditions and environment, and the effectiveness of regulation and inspection.

"My clients suggest to you, no, that the people who bear the risk ought to be able to make the decisions . . . it's those that bear the risk that should decide whether or not they are willing to bear that risk." (Jim Aldridge for Nisga'a Tribal Council, Vancouver, November 1985)


134°
132°
130°
128°
126°
54°
52°
50°40'
— 20 km from landmass - for exploratory drilling (any time of year)
— 10 km from landmass - for seismic survey (March, April, May, November, December)
ALASKA
New Aiyansh
Kincolith
Port Simpson
Terrace
Dundas I
Prince Rupert
DIXON ENTRANCE
Masset
GRAHAM I
Port Clements
Porcher I
Kitimat
Kitamaat Village
Kitkatla
Kemano
BRITISH
COLUMBIA
Pitt I
Hartley Bay
Banks I
Queen Charlotte
Skidegate
Sandspit
HECATE
STRAIT
Butedale
Princess Royal I
Louise I
MORESBY
Lyell I
Aristazabal I
Klemtu
Ocean Falls
Bella Coola
Price I
Waglisla
PACIFIC
OCEAN
Kunghit I
Namu
QUEEN
CHARLOTTE
SOUND
Calvert I
0
100 Km
Port Hardy
Alert Bay
Port McNeill
VANCOUVER I

Current to Nov. 21, 1985

Figure 5: Exclusion Zones from Offshore Exploration Activities

It is evident from information considered by the Panel that many marine life forms are, or could be, vulnerable to an offshore oil blowout. This vulnerability stems from their sensitivity to oil at critical stages of their life cycles, and from the potential for exposing them to oil from a blowout at particular locations, or at particular times of the year. A blowout occurring at some locations at critical times of the year, could create widespread, long-term damage to the ecology of the region.

The Panel concludes that in order to reduce the risk of environmental damage from an offshore oil blowout to an acceptable level, measures must be introduced to reduce the likelihood of occurrence for a blowout and that drilling should be prohibited in some locations. The Panel also concludes that timing restrictions should be imposed on drilling operations, at least until further operating experience is gained and weather forecasting capability is improved.

> **The Panel recommends that the regulatory authority ensure, as a paramount priority, a high level of training, experience and competence for drilling personnel and the highest standard of equipment; also that frequent inspections of systems, equipment, and personnel are carried out, and that a satisfactory level of weather forecasting is available to drilling operators.**
>
> **The Panel recommends that drilling be prohibited within an exclusion zone of 20 km from any point of land for the protection of important marine life in the event of an offshore oil blowout.**
>
> **The Panel recommends that exploratory drilling operations external to the 20 km exclusion zone be initially confined to the months of June to October inclusive to ensure weather more favourable to drilling operations, to mitigate the likelihood of an oil blowout and to protect important biological species during critical phases of their life cycles.**

"It's not only the beauty of the area and the clams on the beach, it's our livelihood, it's our town, our lives are at stake here, given any risk, we know how fragile the economies on the west coast and in this area." (Danni Trib, UFAWU, Sointula Local, Alert Bay, November 1984)

". . . the people here are being asked to risk their livelihood and in fact their very existence so that somebody else can make a buck. And I just wanted to ask you, would you?" (Jim Trerise, Kitkatla, November 1984)

"I cannot overemphasize on behalf of this community that I'm elected to represent the fear that our resources will be wiped out. I liken it to myself taking a bomb of whatever nature, putting it under Mr. Cotterill's seat and ensuring him that I'm not going to touch the wires together." (Gerald Amos, Chief Councillor, Kitamaat, September 1985)

PUBLIC INVOLVEMENT IN MANAGEMENT OF OFFSHORE HYDROCARBON EXPLORATION

Considerable interest was expressed throughout the hearings on the way in which offshore hydrocarbon exploration would be managed and controlled.

Residents of the region who have a vital interest in its marine resources were concerned that the existing management system would not provide them with adequate and up-to-date information on the exploration activities, or allow them to play a role in decisions that could affect those resources. There was a perception that when the environmental review process was over, all opportunities for public participation would end.

". . . I think this is the first time we've ever been involved in making decisions, and this is what we've wanted in the past years when any big project's going to start. We like to get involved, we like to put our views in, and we're very thankful that we're given the privilege, we're given the chance to say our views . . ." (Raymond Stewart, Kincolith, November 1984)

The Panel is sympathetic to this concern and concludes that public acceptance of the risks involved in offshore hydrocarbon exploration would be significantly increased if the public was provided an ongoing role in its management and control.

> **The Panel recommends that a mechanism be established to ensure participation of the public of the region, in ways acceptable to them, in the management and decision-making related to offshore hydrocarbon exploration.**

"We need more community involvement . . . the people in the communities know what's happening. They know about the concerns, the economic problems, the environmental issues that are present, and we strongly believe that the communities have to be more directly involved." (Rev. Peter Hamel, Anglican Church of Canada, Skidegate, October 1985)

ABORIGINAL CONCERNS

To understand the social impacts of an activity, it is necessary to know the people it will effect. There is a wide variety of people in the region, all of whom could be impacted to some extent by offshore exploration. A significant portion of the people residing in the proposed exploration area are native. They reside in the numerous small communities that dot the mainland coast and Queen Charlotte Islands.

When the first Europeans arrived on the west coast of Canada they encountered a number of aboriginal peoples who had occupied that region for countless generations. Over the centuries, rich and unique societies evolved in harmony with the sea, its adjoining land masses, and the resources of each. These societies were complex, politically and socially sophisticated, economically rich and varied. Their dependence on the sea and its resources was reflected in their culture, society, economy, and their view of the world as the sea defined by the land that surrounded it, rather than land defined by surrounding sea.

A complex system of individual and collective ownership had developed with regard to specific areas of land and sea, and with specific resources. The system was supported by oral tradition and by societal structures and institutions. But, with the arrival of the first Europeans, a process began that was to have serious negative impacts on the culture, society and lives of these coastal people. Traditional rights and title to land and resources that had survived the passage of generations were not recognized. Decisions about their resources were made without involving the people who depended upon them.

Vital religious and cultural observances were not understood or accepted. Populations were decimated by disease, and to survive, reduced populations had to combine and relocate.

The sea's resources have retained their importance to these present-day communities. The importance is not just economic, but social and cultural. Their social life is organized around the harvesting of the resources of the sea. Their culture rests on the harmonious relationship between these resources and individuals, and an individual judges himself on his ability to play a personal part in maintaining that relationship. It is a personal obligation demanded by society.

It is within this context that the potential socio-economic impact of offshore exploration on the west coast must be evaluated. Although the risk of an accident is small, the resources threatened are of tremendous importance to coastal native people. Their damage would be felt economically, socially and culturally.

". . . the people assembled here do not just represent a small community, a small isolated community somewhere on the central coast. In fact, they represent the descendents of a major nation, aboriginal nation, that occupied over 6,000 square miles of land and additional adjacent sea waters on the central coast." (Jennifer Carpenter, Waglisla, November 1984)

At this time, decisions regarding these resources are taken outside of the region potentially affected. This is no longer acceptable to these people. A new generation of leaders has emerged. They are sophisticated, educated and exposed to the ways of the larger society. They are determined to take control of the decisions that affect their lives and to have their traditional rights and titles recognized. This renaissance is essential to their social and psychological strength and well being, vital to the political, social and economic stability of the region, and critical in terms of maintaining the basic assumptions upon which our larger Canadian society is constituted. Some means must be found to involve aboriginal peoples in the decisions relating to resource management and development that effect them so greatly.

The Panel concludes that the perception among the aboriginal peoples of the region that traditional rights will be further eroded by their inability to participate in decisions affecting marine resources is likely to be a major socio-economic impact associated with offshore hydrocarbon exploration.

> **The Panel recommends that in designing programs and mechanisms for the involvement of the public of the region in the management and decision-making relating to offshore hydrocarbon exploration and its impact on marine resources, government develop means to ensure that aboriginal peoples are involved.**

> *"The title to the sea and coastal and marine resources, which is vested in the chiefs of the respective First Nations, has never been extinguished by treaty or by any other means and continues to this day. With title, the chiefs have a responsibility to ensure the sound management of the sea and its resources for the benefit of present and future generations." (Matthew Hill, Chief Councillor, Kitkatla, September 1985)*

> *"We have lost many things over the years, I feel, as a people. We have very little land left, there's very little trees left, the culture is going, but we're trying to hang onto it. We can only hang onto that with the sea, and the food, that's the only things we've got today." (Diane Brown, Queen Charlotte City, November 1984)*

COMPENSATION

Throughout the hearings, a great deal of interest was expressed as to the type of compensation arrangements that would be put in place to deal with property or economic losses that might arise from offshore petroleum exploration.

Of particular concern was the potential for substantial losses of income and important marine resources, in the event of an offshore oil blowout.

Industry and government regulators believe that the likelihood of an offshore blowout is extremely remote. Consistent with this view, the Panel believes that a compensation arrangement which is clearly weighted towards the protection of the public would not be unduly onerous to industry, and would be reassuring to the public.

A satisfactory compensation arrangement must be capable of settling disputes quickly and fairly. Throughout the hearings, the view was expressed that fishermen and small businesses would not have the financial resources to successfully press disputed claims against companies in the oil industry. It was believed, also, that the civil law system was too time consuming and too expensive to be a practical means of adjudication. A particular problem was seen in some cases where the burden of proof for justifying the extent of an economic loss, and for establishing the agency responsible for damage, was placed upon the claimant.

Another aspect of compensation which the Panel believes to be important was with regard to the loss of important marine resources. Conventional compensation approaches have not dealt with this type of loss because the resources are generally considered to be a common property until the time when they are commercially harvested or exploited. It is also generally accepted that government, as the steward of these resources, will have absorbed the liability for any damage to them when authorizing the activity which ultimately caused the damage.

There are additional problems in identifying the nature and extent of common property resource damage, and in identifying an economic value that could be attached to that damage for the purpose of compensation. The Panel did not believe that these difficulties were sufficient to warrant not dealing with this important aspect of damage and compensation. To overcome difficulties associated with identifying a value for the damage to or loss of common property resources, compensation could be in the form of resource replacement programs. The extent and nature of the programs that would constitute appropriate compensation would be determined by government as the overall steward of those common property resources. Their own responsibility in authorizing the activity that caused damage to the resource should be met by government accepting a formal liability for compensation equal to that of the agency actually causing the damage. This would also place a control on the amount of compensation believed to be necessary.

The Panel recommends that a government compensation policy covering all stages in an exploration program be established before any exploration activity begins.

Further details on this recommendation are explained in Section 11 of the report.

RESEARCH

The mandate of the Panel included a request to identify "... information gaps which may prevent a full assessment of impacts and risks prior to the commencement of exploration...". Implicit in this request was the need to define the research and studies necessary to identify:

1) the probable effects on the environment based upon the types of known disturbances created by offshore exploration operations; and

2) the probable effects of the physical environment of the region on these exploration operations.

Also implicit in the material provided by Chevron and Petro-Canada was the assumption of a limited exploration program. The Panel's mandate, however, required the examination of a much wider and expanded exploration program including delineation drilling following the discovery of a significant quantity of oil or gas.

Studies and research applicable to offshore exploration attempt to establish one, or all, of four factors concerning impacts: the nature of the disturbance, how the disturbance evolves, its effect on some areas of particular interest, and how to mitigate and avoid the effects.

In theory, studies and research will yield satisfactory answers. Often, however, practical barriers exist to achieving precision. These could be lack of resources, lack of sufficient time, lack of will to proceed and, of importance in this region, lack of basic knowledge of the special resources of the region which might be affected.

The reality is that research and studies developed to support environmental and socio-economic assessments seldom yield definitive results.

The benefit of this kind of research is mostly in helping to verify or to refute the accuracy of educated guesses. As a consequence, the Panel has attempted to avoid a dependence on research results and has concentrated on disturbance removal by, firstly, recommending ways in which the sources of disturbance can be removed from whatever might be affected and, secondly, recommending ways to reduce disturbance.

The fundamental problem of all management authorities is that a vast amount of resources can be committed to research which yields only a marginal improvement in the ability to make decisions.

The documentation and submissions reviewed by the Panel, and the information presented at public hearings, revealed significant gaps in the environmental and socio-economic knowledge of the region.

The gaps included: a considerable lack of basic inventory information, such as the presence and seasonal distribution of marine mammal species, birds, fish and invertebrates, and an absence of knowledge on how local environmental and social systems operate, particularly with regard to relationships between species in foodwebs and with their habitat. These gaps of information are not necessarily significant in themselves. They may not seriously inhibit the ability to make decisions on the basis of current levels of information. In considering a long-term exploration program, however, they could be important.

In some parts of the region, these knowledge gaps can reduce the level of confidence decision-makers may have in the hypotheses they have developed for the purpose of assessing impacts. It is for this reason that the Panel considers it imperative that any expansion of exploration beyond the limited two-well program proposed by Chevron be preceded by a considerably expanded research and study program.

The rationale for the particular research and studies recommended by the Panel is described in various sections of the report. In Section 14 "Action Plan", research is separated as to when it should be initiated and completed with respect to the various stages of the exploration program, in particular prior to seismic surveying and prior to the start of exploration drilling.

The Panel concludes that studies and research should focus principally on these two initial time thresholds of exploration. If an expanded exploration program is proposed, a more expanded inventory data acquisition program, and effects research program, should proceed. The Panel expects that the environmental management authority it recommends in Section 13 would coordinate these research programs.

5. SEISMIC SURVEYING

Seismic surveys are invariably carried out in advance of exploratory drilling and may also be conducted during later stages of an exploration, delineation or development program in order to obtain better definition of earlier data.

The purpose of seismic surveys is to locate rock strata configurations potentially favorable to the trapping and accumulation of hydrocarbons. These might include uplifted, domed and folded strata, and must include an impermeable rock seal that provides a cap on fluids trapped within. Into these configurations hydrocarbons, often created elsewhere, can migrate and become trapped. Hydrocarbons may also be created in situ in these configurations.

Seismic surveys involve measuring the speed of sound waves in various strata below the seabed.

A bank of 15 to 36 airguns are towed in an array about 150 m wide and 50 to 100 m behind the seismic vessel at a depth of about 12 m. These airguns produce a sound impulse every 15 seconds by releasing air under high pressure (up to 150 kilograms per square centimetre). The sound energy is most intense for frequencies between 10 and 80 Herz. An underwater hydrophone train is towed behind the vessel along the length of a 3-km cable. The hydrophones record the sound impulses reflected back to the surface from subsea geological structures. Variations in the measured sound speed are translated into vertical cross-sections, which show differences in the depths and thicknesses of rock layers beneath the seabed. From these cross- sections, contour maps of possible trapping configurations are produced.

Figure 6 is a schematic diagram of a seismic vessel in operation. The vessel is between 40 and 60 m in overall length, and operates in survey mode at about 5 knots. At this speed, it takes about 20 minutes for the seismic vessel and cable to pass a given point. The vessel carries a crew of about 40 scientists, technicians and marine personnel.

The seismic surveys proposed by Chevron would traverse a distance of about 5,200 km in lines spaced 3 to 6 km apart within southern Hecate Strait and in Queen Charlotte Sound. Chevron expects initial seismic surveys to be completed in two summers.

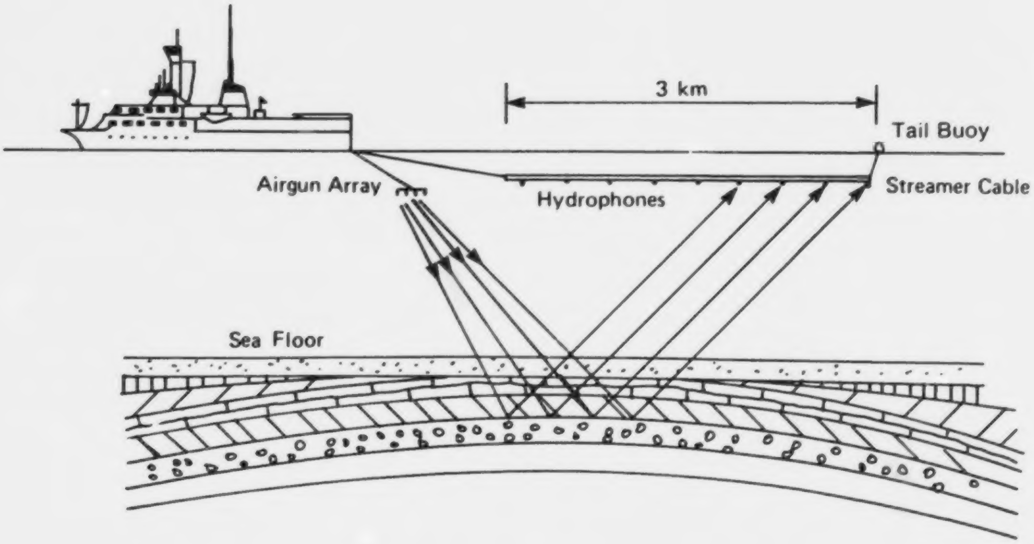


Figure 6: Seismic Vessel in Operation

EFFECTS OF THE PHYSICAL ENVIRONMENT

Marine seismic operations require considerable searoom because of the 3-km hydrophone streamer train and consequent large turning radius. In addition, the airgun arrays cannot operate in shallow depths. As a result, seismic vessels would generally stay at least 5 km from shore.

A further limitation is the need for low seastates to limit ambient sea noises that could mask weak seismic signals. Chevron intends to undertake seismic operations in the summer to ensure a minimum of sea noise and a maximum of daylight hours.

Poor visibility in fog and rain would have little effect on seismic operations.

The Panel concludes that physical environmental factors will have minimal impacts on seismic survey operations. Awareness of operating conditions and adherence to government regulations will minimize mishaps.

BIOLOGICAL EFFECTS OF SEISMIC OPERATIONS

The effects on marine organisms of sound from seismic survey operations varies according to the sound source. The noise of the seismic vessel itself could affect marine organisms, but the effects would likely be similar to those associated with other ocean-going vessels and thus be insignificant.

Concern was expressed throughout the review about the effect of percussion from seismic airguns on fish eggs, larvae and juvenile fish. The Panel shares this concern. A wide variety of often conflicting information exists on the effects of airgun percussion on these organisms. On the one hand, observations from other areas of the world where extensive seismic surveying has been conducted over many years, such as the North Sea, the Canadian east coast, the U.S. Gulf Coast, Australian and Southeast Asian waters and the Arabian Gulf, strongly suggest that little adverse effect to biota has resulted from more extensive and dense surveying than is likely to occur on the west coast. They also showed that in many of these areas, particularly in earlier days, much more potentially damaging explosive methods of seismic surveying were used.

On the other hand, a Russian study (Kostyuchenko 1973) observed several pathological changes occurring in an organism subjected to airgun impulses. The findings of this study were cited several times during the hearings.

In addition, the Panel was informed that, in certain coastal states in the United States, a moratorium has been placed on all seismic surveying until the matter of the degree of airgun percussion damage to fish eggs and larvae has been satisfactorily resolved.

The Panel is also aware that such data as is available on this matter has come from experimentation using a single airgun, not with the 150 m wide, 36 gun array now in general use.

Populations of fish eggs and larvae are abundant and widespread throughout the region and many groundfish spend the embryonic, larval and juvenile stages of their lifecycle, lasting from six months to a year, in the upper water column through which the airgun arrays are towed. These organisms are not uniformly distributed in the upper layers of the sea but are likely to concentrate at tide rips and other flow convergences and in areas of enhanced biological productivity. An array of airguns operating in such places might significantly affect large populations of fish species. Since information is lacking on where and when such concentrations occur and how they could be detected on a routine basis, avoiding them might be impossible. In particular, research on the likely extent of damage to icthyoplankton and juvenile fish should be directed to determine whether or not population level damage is likely to occur to any one species. Therefore, better knowledge of seasonal concentrations of these species is certain to be needed.

"IPS feels that seismic testing causes disorientation in cetaceans, and fears that one result of seismic testing might be that of some species of cetaceans will simply leave the area." (Susan Williams, Islands Protection Society, Vancouver, November 1985)

If the initial exploration program produces encouraging signs of an oil or gas accumulation, a long-term exploration program, including additional seismic surveying, could result. Other operators may ultimately be involved in conducting their own seismic programs. Seismic survey impacts, therefore, must not be assumed to be limited to those associated with Chevron's two year program.

Given the considerable lack of knowledge about the affects of seismic airgun percussion on fish eggs, larvae and juveniles, and about the distribution of these organisms in the review area, the Panel believes that extreme caution must be used in permitting seismic operations, and that initially only a limited portion of the whole review area should be covered by seismic surveys in any given year. The Panel believes that the opportunity should be taken to obtain better information concerning the possible impacts of seismic surveys.

The Panel recommends that:

1. **a seismic survey program such as that proposed by Chevron be permitted to proceed, providing that half the program is conducted in the first year of operation and the remainder in the second year;**
2. **the program be conducted with no less than a 3-km line spacing pattern, and a maximum survey length of 5,200 km;**
3. **during both seasons of seismic surveying, the Department of Fisheries and Oceans carry out extensive monitoring and experimentation in conjunction with the seismic survey vessel to determine the nature and extent of any resulting damage;**
4. **such data collection and experimentation be used by the regulatory authority to determine the likely long-term effects of seismic operations on marine biota, particularly eggs and larvae, and be applied in determining the appropriate controls and regulations to any future seismic surveys; and**
5. **until such time as the results of monitoring and experimentation have been evaluated, no other marine seismic survey operations be permitted.**

More information was available to the Panel on the effects of seismic operations on species of larger fish. Chevron cited a number of studies that suggested the lethal range for various larger organisms was between 1.5 and 5 m for typical airguns. Both the Department of Fisheries and Oceans and the British Columbia Ministry of Environment concluded that the short range within which lethal or sublethal effects are likely to be experienced, render the impacts on populations of larger fish to be negligible.

Studies done on the effects of seismic operations on marine mammals generally agree that, while seismic noise disturbs most mammals, the effects are primarily localized and temporary since many mammals rapidly habituate to the disturbance. However, the Panel believes that because the level of disturbance is not known with a sufficient degree of certainty, migratory marine mammals should be avoided as much as possible. As otters, seals and sea lions are most commonly found in nearshore areas, and as the majority of cetaceans also feed in the same areas, the Panel believes that coastal zones should be excluded from seismic surveying at particular times of the year.

Gray whales generally migrate northward in April and May and southward in November and December, consequently, these months will be sensitive to seismic survey work. Herring spawn in March and April so this period will also be sensitive to seismic surveys. The Panel concludes that it would be desirable to avoid conducting seismic surveys during these sensitive periods.

The Panel recommends that during the sensitive gray whale migration and herring spawning periods of March, April, May, November and December, seismic operations not occur within 10 km of shore.

The Panel recommends that when marine mammals are observed within 2 km of the airgun array, the survey temporarily cease until the mammals have moved out of the area.

Figure 5 shows the boundaries of the 10 km exclusion zone.

OPERATIONAL CONSIDERATIONS

The difference in impacts between underwater airguns and underwater explosives was mentioned a number of times during the hearings. Although Chevron does not now intend to use explosives, known to be more destructive, they may ultimately be required in some situations, such as in making "tie-ins" to connect land and sea surveys. **The Panel concludes that the use of explosives could be requested to deal with some special circumstances, and should be subjected to special permission and conditions.**

The Panel recommends that, for purposes of general operations, seismic surveying be restricted to airguns only.

The Panel recommends that where the use of explosives in shallow water seismic surveys is required to connect land and sea surveys, approval only be granted where:

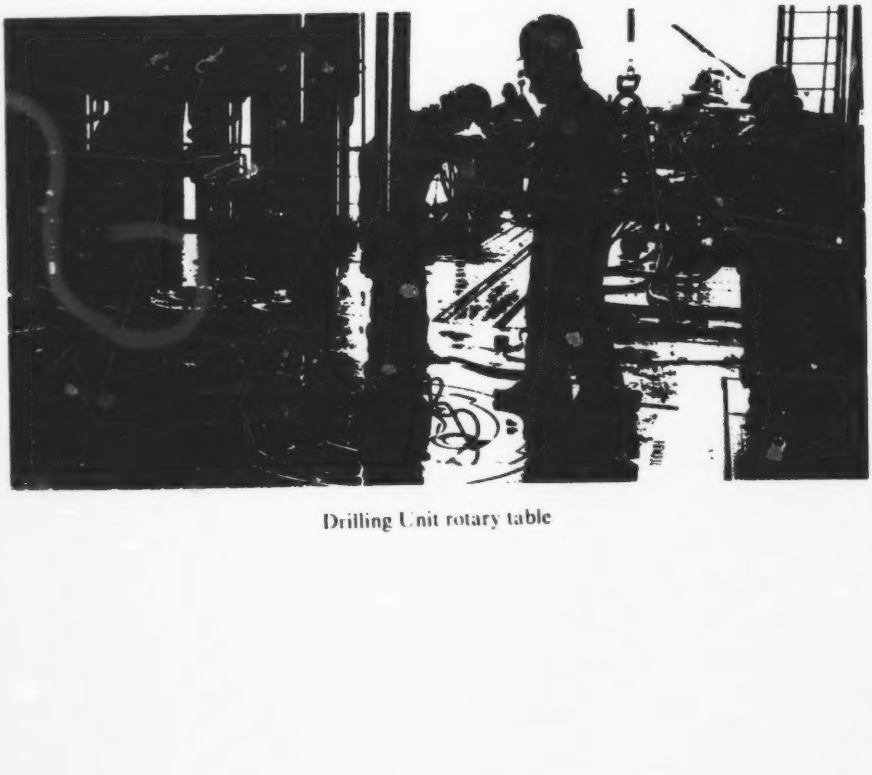
1. **there are no alternatives;**
2. **explosives are buried within boreholes within the sea floor; and**
3. **the program is subjected to specific approval from the Department of Fisheries and Oceans as to timing and location.**

Due to the length of the hydrophone streamer train towed behind the survey vessel and the slow speed at which the vessel operates, it is important that other marine users be aware of the general location and direction of seismic vessel activities. It is also important that the operator of the seismic vessel be aware of major fishing grounds, seasonal openings, and areas of heavy marine traffic. Knowledge of local fishing equipment such as buoy markers for crab pots and trawling nets is also essential.

During the public hearings, fishermen said they were concerned that they could be asked to move off a fishing ground located along a prescribed seismic survey line. Chevron expressed its intention to disturb the commercial fishing activity as little as possible and to detour around areas of fishing activity. Chevron also indicated that good communications between the seismic operators and the local fishermen's associations were essential to prevent conflicts. The Panel agrees.

The Panel recommends that booklets be produced and widely distributed describing the fishing techniques employed on the British Columbia coast, illustrating the different methods and seasons used to catch fish and shellfish, and describing seismic survey operations.

The Panel recommends that the operators of the seismic vessels meet with the members of the fishing industry before surveying begins to identify potential heavy fishing areas and seasons and to familiarize themselves with the local fishing equipment and techniques.



Drilling Unit rotary table

6. ROUTINE EXPLORATORY DRILLING AND SUPPORT OPERATIONS

This section includes a description of the rotary drilling method and marine exploratory drilling techniques and procedures, followed by consideration of interactions between routine exploratory operations and the region's environment.

ROTARY DRILLING TECHNIQUE

Drilling for oil and gas is generally carried out using the "rotary" drilling method. This method is exclusively used offshore. At least 5000 rotary drilling units or "rigs" are currently available worldwide.

The rotary drilling method for cutting a near vertical or vertical cylindrical hole through the earth's crust depends upon:

1. the weight on the cutting tool ("the bit") at the bottom of the hole;
2. the rotation of the bit on the bottom of the hole by means of rotating, from the surface, the entire pipe assembly (drillstring), to which the bit is attached; and
3. the circulation down the drill string of drilling fluid or "mud" to the bit to remove the rock cuttings and to control formation pressures.

The mud is pumped from a surface tank down the pipe ("drill pipe") to the inside of the bit, out around the cuttings on the bottom of the hole, and up the outside between the hole and drill pipe to the surface. The space between the rotating drill pipe and wall of the hole is called the "annulus".

Weight on the bit is accomplished by running in the hole, between the bit and the drill pipe, several lengths of extremely heavy thick-walled pipe, called "drill collars". Drill pipe may weigh up to 30 kg/m. Drill collars, of larger diameter than drill pipe and of constant diameter throughout, can weigh up to 150 kg/m. The full hanging weight of the whole assembly in the blocks in the derrick (bit, drill collars and drill pipe), which is continually monitored by the driller at the rig floor, is gradually paid off by lowering the whole string until the bit rests on the bottom of the hole with the precise desired weight applied to it.

The bit is then rotated by turning the entire drillstring on which it is threaded. Rotation is obtained by using a square or hexagonal joint called a "Kelly", thread-connected to the top of the drillstring and hanging from the blocks and a swivel in the derrick. This swivel permits the entire drilling assembly to freely rotate. On the Kelly is a bushing, which is free to move up and down, and which engages in a fitted recess in a rotating table (the "rotary table") on the drill floor. As the table rotates, it engages the bushing and Kelly, and hence the entire assembly down to the bit. Attached to the top of the swivel, but not rotating, is an armoured rubber hose or "gooseneck". This leads from the discharge of the mud pumps on the rig floor and conducts mud down the drillstring to the bit at the bottom of the hole and up the annulus.

CASING

As a well is drilled and the hole deepens, progressively smaller diameter holes are cut, with the walls of each size hole supported and protected by progressively smaller diameters of rigid pipe, or "casing", cemented in place. Casing is made in standard sizes, with outside diameters of 30 in (750 mm), 20 in (500 mm), 13 3/8 in (340 mm), 9 5/8 in (240 mm), 7 in (175 mm) and smaller.

To case a hole, the drillstring is pulled from the hole, every third drill pipe collar connection being unthreaded, and the lengths stacked in the derrick. When the drillstring is out, the casing string is assembled joint-by-joint and lowered into the hole to the depth required, usually to the bottom. A cement slurry is then pumped into the casing from the surface in sufficient volume that it will fill most or all of the void between the outside of the casing and the hole. A cylindrical plug of the same diameter as the inside diameter of the casing is then inserted above the cement, and mud is pumped in to force the plug and the slurry downwards. The slurry then flows around the bottom "shoe" of the casing string and up into the annular void (casing annulus). The plug comes to rest on the shoe inside the casing. The rig is then shut down for up to 24 hours to allow the cement in the annulus to harden. The blowout preventer stack is adapted for the casing size and then remounted on the wellhead. Drilling then resumes through the cemented casing with a smaller diameter bit.

When it becomes necessary to case a hole drilled deeper by the smaller diameter bit, the procedure is repeated, but with a smaller diameter casing string.

DRILLING MUD

Drilling mud is a complex liquid with a large variety of properties. It is based upon water or, in some cases diesel or mineral oil, to which is added, by strong agitation, sufficient very fine, dry clay microparticles (Bentonite) to

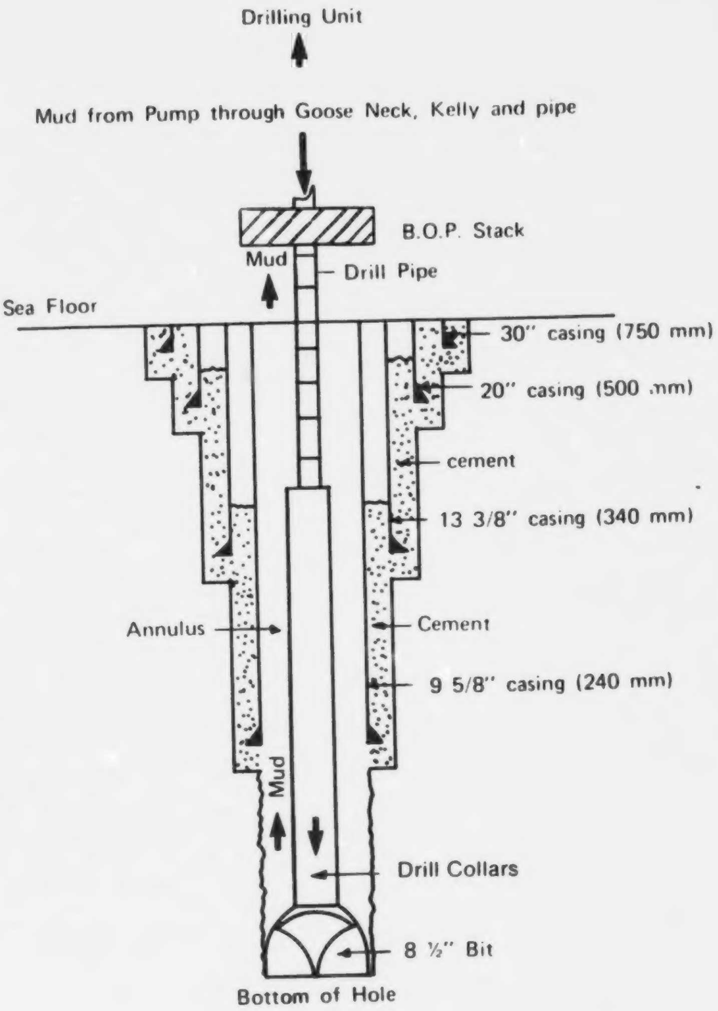

Drilling Unit
Mud from Pump through Goose Neck, Kelly and pipe
B.O.P. Stack
Mud
Drill Pipe
Sea Floor
30" casing (750 mm)
20" casing (500 mm)
cement
13 3/8" casing (340 mm)
Annulus
Cement
9 5/8" casing (240 mm)
Mud
Drill Collars
8 ½" Bit
Bottom of Hole

Figure 7: Typical Schematic Rotary Drilling Configuration

form a stable colloidal suspension of slightly greater density than water. To this suspension, various compounds may be added to produce or accentuate particular properties. Barites may be added (and held in suspension) for extra density, tannins and lignosulfonates for thinning properties, caustic soda for pH control, biocides for corrosion control and carboxymethyl cellulose (CMC) or starch for gelling and filter cake properties. Several other controllants are available, particularly plugging materials for leak zones. The mud is built up to the required properties, particularly of density and viscosity, separately for each well, depending on circumstances. Drilling mud additives are generally delivered to a well in the form of dry sacked material. When drilling is completed, the hole is full of mud. This mud is left in the hole with cement abandonment plugs sealing it in place. Unlike water-based muds, oil-based muds can often be reused.

The primary functions of the drilling mud are as follows:

1. To provide well control. This is accomplished by providing a hydrostatic column of fluid of sufficient density to counter- balance and contain any natural pressure contained in a drilled oil or gas-bearing formation, and prevent the oil or gas (or both) from entering the borehole and threatening a blowout. Extra density, and thus bottom pressure, can be supplied as required.

2. To provide a viscous mud flush to pick up the small cut rock formation particles under the bit ("cuttings") and convey them to the surface where they can be separated from the mud, cleaned, examined and identified by the geologist.

3. To provide a cake or skin against penetrated permeable formations. This is firstly to prevent leakage into these formations (lost circulation) and consequent loss of the hydrostatic column and, therefore, pressure. This would lead to loss of well control. It is also to provide thin filter cakes over less permeable zones, particularly those containing oil or gas, to protect them from particle plugging and from surface tension blocks between in situ oil and the water from the mud. Filter cakes also help preserve the integrity of the hydrocarbon zone so that electrical, sonic, radioactive and other measurements of formation properties taken in the hole are relatively unaffected by the invasion of mud.

4. To provide a gel under static conditions to prevent cuttings from falling back down the hole and jamming the collars and bit, leading to costly tool retrieval operations ("fishing").

Other functions of mud are slightly less important and include picking up traces of oil and gas from potential hydrocarbon producing zones for surface monitoring, providing a tell-tale tank level to monitor mud losses (formation "kicks"), and lubricating and cooling the bit to increase its penetration rate.

BLOWOUT PREVENTION EQUIPMENT

A weighted mud column is the first line of defense against a blowout. The second line of defense against a blowout from pressured formations is a control assembly of very heavy remote-controlled valves called the blowout preventer "stack" or BOP. All rotary drill rigs use blowout prevention equipment. The BOP stack consists from the bottom up of:

a) a pipe ram valve (BOP) capable of closing sealing rams around the drill pipe in the hole thus sealing the hole annulus;

b) a blind ram BOP capable of shearing through drill pipe in the hole and completely sealing the hole from the atmosphere; and

c) at least one bag-type BOP capable of closing firmly around any type or shape of pipe or tool in the hole, such as drill pipe, drill collars, core barrel, bit or casing.

When pipe rams and bag-type BOPs are actuated on pipe in the hole, the inside of the drillstring in the hole must also be controlled. This is done by pumping heavier and more appropriately designed mud into the hole, or by closing a sealing cock contained in the Kelly on the drillstring ("Kelly-cock"). Control valves, kill lines and choke assembly lines are provided to allow access to the annulus after BOPs are closed to enable control operations to be implemented.

MARINE OPERATIONS

MARINE RISER

In offshore exploration operations, a marine riser is used to traverse the seawater layer between the rig at the surface and the BOP's which are located at the seabed, and also to provide a conduit for the mud and drillstring. This is a moderately flexible piping extension of the well, of somewhat larger diameter than the largest casing. The exploration rig and its marine riser can be disconnected from the top of the BOPs in an emergency, leaving the well shut-in.

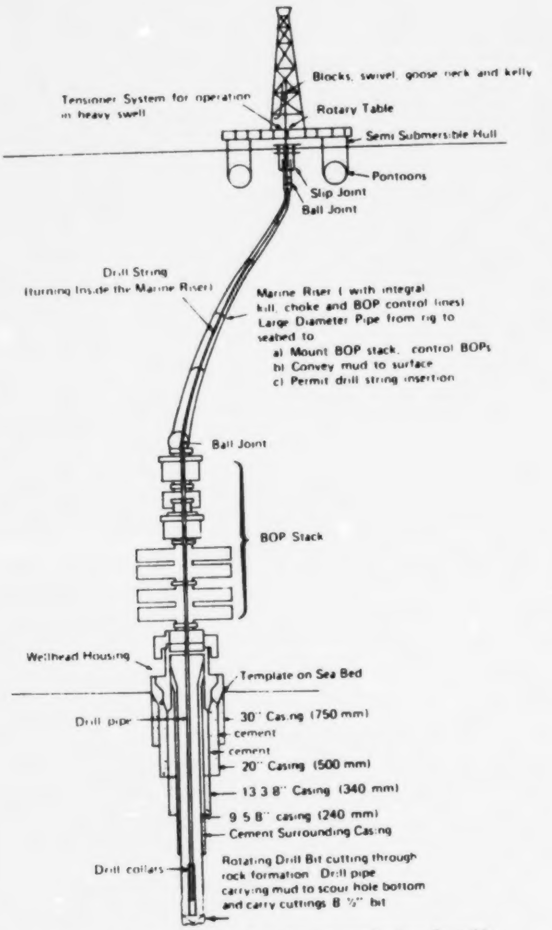

Blocks, swivel, goose neck and kelly
Tensioner System for operation in heavy swell
Rotary Table
Semi Submersible Hull
Pontoons
Slip Joint
Ball Joint
Drill String (turning Inside the Marine Riser)
Marine Riser (with integral kill, choke and BOP control lines)
Large Diameter Pipe from rig to seabed to
a) Mount BOP stack, control BOPs
b) Convey mud to surface
c) Permit drill string insertion
Ball Joint
BOP Stack
Wellhead Housing
Template on Sea Bed
Drill pipe
30" Casing (750 mm)
cement
cement
20" Casing (500 mm)
13 3 8" Casing (340 mm)
9 5 8" casing (240 mm)
Cement Surrounding Casing
Drill collars
Rotating Drill Bit cutting through rock formation. Drill pipe carrying mud to scour hole bottom and carry cuttings 8 ½" bit

Figure 8: Typical Offshore Semi Submersible Drilling Assembly

DRILL RIG SUPPORT MOUNTINGS

The rotary drilling method is used exclusively offshore. There are three options for support mounting for such rigs:

1. The Jack-up. This is a seabottom supported assembly used in relatively shallow water of depths up to 100 m, and would be applicable in the subject area only in certain restricted localities.
2. The Drill Ship. This has a ship's hull with the rotary drill rig mounted amidships. It is positioned with anchors and conducts drilling much the same way as the semi-submersible described below. It is unsuitable for operation in high seas.
3. The Semi-Submersible. This is a large, rugged, stable, custom-built floating structure on which the rotary rig is mounted. It is generally constructed with twin parallel pontoon hulls, which are capable of being ballasted down to a buoyancy affording relative stability. It can be anchored in water up to 400 m in depth or dynamically positioned in all depths of water by computer-controlled thrusters.

In areas of adverse weather and sea conditions, semi-submersibles are now in universal use. While at least two serious weather accidents have occurred involving semi-submersibles, both accidents being due to design faults coupled with human error, their safety record is nevertheless good, and a large number of wells have been drilled by them in all parts of the world in adverse conditions. They can drill safely when both 10 m waves and 50 knot winds occur together. After discontinuing drilling and breaking seabed connection, they can survive at least 30 m waves. An early design of semi-submersible, the Sedco 135F, was used by Shell on the British Columbia coast on a year-round basis in the late 1960's for 14 wells without adverse incident.

Semi-submersible rigs are proposed for exploratory drilling in the region.

> *"... the size of this rig is about the size of a 35 storey building, and the deck is about a football field square ..." (Charlie Stewart, Chevron, Hartley Bay, November 1984)*

MARINE DRILLING OPERATIONS

Once seismic surveys have located a suitable prospect area and seabed site surveys have been completed, a drill rig is moved to the site and anchored. Figure 8 is a schematic of a typical offshore semi-submersible drilling assembly. Standard procedure is as follows:

A short hole, 30 m x 914 mm (36 in) diameter, is drilled through a seabed template without using a marine riser. The first casing, 762 mm (30 in) diameter is then set and cemented in place. Drilling fluid returns to the seabed and is generally water only.

A 660 mm (26 in) hole is then drilled to 250 m and a 510 mm (20 in) conductor casing is then cemented in place. Both holes are drilled without a marine riser and water is generally used as the drilling fluid. After cementing the 510 mm conductor, the marine riser and BOP stack are installed from the seabed to the rig to convey drill cuttings and mud to the surface. The BOP stack is run on the bottom of the marine riser and connected to the top of the 510 mm casing by a ball joint, and to the rig by a ball joint and slip joint. Mud is then used as the drilling fluid.

The BOP assembly is completely furnished with all remote controlled hydraulic lines and risers and access lines to the well. All equipment is then in place to run the drillstring and drill the surface hole, 445 mm (17½ in) to 1000 m. Surface casing of 340 mm (13 3/8 in) diameter is then cemented and an intermediate hole of 311 mm (12 1/4 in) is drilled ahead to about 2,500 m; the next string of casing is 245 mm (9 5/8 in). Penetration of 50 m per day is typical in deeper formations.

If a discovery is indicated, generally by monitoring mud by gas chromatography and by making periodic electrical, sonic and radioactive measurements, the formation may be tested. In the interests of safety, this is generally done after the entire length of the hole is cased. If a discovery results, several delineation wells will be necessary, probably one in each quadrant from the discovery well. These wells will confirm the presence of hydrocarbons, their nature and composition, and determine the extent of the accumulation, productivity and economic viability of the find.

SUPPORT OPERATIONS

Both Chevron and Petro-Canada favour Prince Rupert as a main base for exploration support activities. Prince Rupert has good rail, road, air, harbour and dock facilities. Bulk material and major drilling equipment and materials arriving by road and rail could be stored in an open warehouse on the dock and transported to the drilling operation by supply ship as required. Crews could commute from outside Prince Rupert by air and transfer to helicopters for the flight to the drilling unit.

Based on information provided by the companies, the requirements for a supply base are expected to be about 500 sq m of office space, 1000 sq m of covered storage, up to 10,000 sq m of open storage, a dock area of about 200 sq m, and a helicopter pad. Employment would likely consist of 10 people at the supply base and about 25 people on the supply boats. Accommodation facilities to house, on an occasional basis, up to 30 people would also be required.

Some fuel, food and supplies would be purchased locally. A communications network incorporating SatNav, Loran, satellite telecommunications, VHF and SSB radio, telephone and telex would be required. Government and industry would provide a weather monitoring and forecasting system including sea state reports.

Two or three supply vessels would support each drilling unit. One vessel would always remain on standby at the drilling unit, while others would shuttle supplies and waste materials between drilling unit and shorebase.

Supply vessels are specialized vessels about 80 m in length. They have a crew of between 12 and 14 and operate at speeds up to 12 knots.

One or two long-range helicopters would make several round trips per week to each drilling unit carrying crew members and light cargo.

OIL AND GAS RESERVOIRS

An oil or gas accumulation is not a large unbroken pool of liquid and gas hydrocarbons held in a massive open cavity deep in the earth. The oil or gas or both are held in the tiny microcavities of compacted massive rock, analogous to those in a rigid rubber sponge. They are invariably associated with water in the pores. Considerable surface tension exists between rock, water, oil and gas, within these microcavities. The ratio of total microcavity to bulk rock is called "porosity". The ability of the porous cavities to allow liquids to pass through, (as in a producing well situation) is called its "permeability".

ENVIRONMENTAL CONSIDERATIONS

In this section, the effects of the region's physical environmental conditions on routine exploration operations, and the effects of routine exploration operations on the region's environment, are examined. Weather, weather forecasting, sea conditions, earthquakes, tsunamis and subsea geological hazards are considered in evaluating the effects of the environment on operations. Domestic and drilling wastes, oil-based drilling muds, minor spills, underwater and airborne noise, rig lights, shorebases, seabed obstructions and conflicts with shipping have potential effects on the environment.

EFFECTS OF THE PHYSICAL ENVIRONMENT ON OPERATIONS

Marine weather, oceanographic conditions, earthquake hazards and seabed conditions of the exploration area affect the design criteria for the drilling units and marine risers, the time available to the operator to carry out activities safely and effectively, and the ability to shut down safely in the event of danger to the drilling unit.

Waves, Storms and Currents

Severe storms affect offshore drilling activities by making it difficult to undertake such sensitive operations as landing the BOP stack, running casing, production testing, reconnecting to a wellhead, landing a helicopter or loading fuel.

Problems connected with atmospheric and oceanographic phenomena can be mitigated to some extent by timely warnings of storms and by having a comprehensive oceanographic database. However, many intervenors questioned the quality and accuracy of both meteorological and oceanographic data in describing the offshore environment. Concerns were expressed that British Columbia's offshore weather records were less complete, and covered a shorter period, than other areas where offshore drilling has taken place.

Concerns were also expressed about the ability to predict rapidly developing storms called "maritime bombs". These storms originate over the open ocean and some can grow into full strength storms within eight hours. At present, they are difficult to predict because the upstream weather sensing system is not dense enough to fully monitor the area. Furthermore, no models exist that adequately explain the rapid build-up of extreme waves in shallow areas with strong currents, such as occur in Hecate Strait.

> *"I believe the absolute minimum disconnect time when you move off with marine risers suspended in place but disconnected from the stack is about 30 seconds . . . The drill pipe is sheared off and everything is left in the hole. And that can be done, under dire emergency conditions, in a very short period of time. Our normal process, if we had to do it, would require up to 10 hours." (Pat Haines, Chevron, Alert Bay, September, 1985)*

The Department of Fisheries and Oceans, Environment Canada and the British Columbia Ministry of the Environment also expressed concern over present capabilities to forecast storms, high waves and strong currents. Both Environment Canada and the British Columbia Ministry of Environment mentioned that the speed with which storms can cause operating conditions to deteriorate is a significant aspect of determining routine operational safety. The Atmospheric Environment Service of Environment Canada recommended that before drilling takes place, a review be undertaken of the meteorological and oceanographic real time data observing network currently available. The study would determine if the present network will provide storm warning with sufficient accuracy for offshore operations.

At the present time, the Pacific Weather Centre, operated by the Atmospheric Environment Service, is introducing major improvements in its marine weather forecasting services. Many of these improvements are the result of a special inquiry, commissioned by Environment Canada in 1984, into weather services on the west coast. The Panel concurs with the recommendations of the report that deal with improvements in data acquisition, the broadcasting and dissemination of weather information, and continued research into and development of forecasting techniques.

Chevron stated that it will work closely with the Atmospheric Environment Service and intends to deploy a drifting buoy network and possibly several moored buoys to assist with the provision of improved weather forecasting services. **The Panel supports this approach but believes that an expanded data collection program, and an enhanced monitoring and reporting network, will be necessary before safety of drilling operations can be assured.**

The Panel concludes from evidence presented at the hearings that six hours notice of impending storms is the minimum time required to temporarily cease operations, make the drillstring secure and safely disconnect from the wellhead. There is no assurance that the present weather forecasting network can provide this degree of advance notice.

The Panel recommends that the regulatory authority not give approval to drill until the Atmospheric Environment Service of Environment Canada is satisfied that the capability exists to provide a minimum of 6 hours advance warning of severe storms to enable an offshore drilling operator sufficient time to safely and efficiently disconnect from the wellhead.

The Panel believes that its recommended restrictions on the times of year when drilling can initially occur will result in the avoidance of seasons when storms are most likely to be severe.

The Department of Fisheries and Oceans has undertaken a number of studies to improve the present data base on waves and currents in the north coast area, including wave climate studies, subsurface current studies, and over-ocean wind studies. These are important in setting design criteria for drilling equipment, such as for drill rigs, marine risers and anchoring systems. **The Panel believes that more information on ocean currents is required in order to establish adequate design criteria.**

The Panel recommends that the Department of Fisheries and Oceans develop and implement a program to improve general knowledge of current movements in the region, and in particular, in the area of a drilling location when one is proposed.

Information on surface currents is also required to assist with oil spill trajectory analysis. The issue of oil spill trajectory analysis is dealt with in Section 10.

Earthquakes

Offshore drilling hazards related to earthquakes include the potential for wellhead or casing damage, resulting from drilling in a crustal fault that slips, and from sediment slumps on the sea floor and resulting turbidity flows. Turbidity flows consist of highspeed flows of sediment mixed with water that sweep the seabottom much as a snow avalanche occurs on land.

A detailed site survey, as described by Chevron, will enable sites with crustal faults to be avoided. **However, the Panel believes that assurance should be provided that turbidity flows are not a hazard at a chosen drill site or, if a hazard should exist, that the well would be or would remain safely shut-in if a turbidity flow damaged or impinged upon the wellhead assembly.**

The Panel recommends that before drilling occurs, a proposed site must be evaluated by the operator and the regulatory authority for its potential susceptibility to earthquake-induced turbidity flows, and that if the potential exists, wellhead design will be such that the well remains safely shut-in.

Tsunamis

A tsunami is a sea wave generated by seismic disturbances in the ocean floor. It is a shallow-water wave, with a typical wavelength in excess of 200 km. Tsunamis can move at speeds greater than 700 km/hr, but are not readily observable in the deep ocean where their wave height may only be 0.5 m. However, when a tsunami reaches the coast, it slows down and the water begins to pile up to form crests that may exceed heights of 30 m. Physical damage to offshore structures could occur if these structures were located in shallow water. **Adoption of the nearshore exclusion zones recommended by the Panel would eliminate the potential for damage to offshore equipment by a tsunami in the exploration area.**

Natural Hazards of the Seabed

Seabed conditions sometimes present foundation difficulties to the driller, even when the drill unit used is a semi-submersible having no direct contact with the seabed. Seabed slope, shallow fault traces on the surface, a tendency for loose sandy seabed formations to flow and slump, unexpected deep holes in the seabed, and other bottom features must all be closely investigated before a final anchoring and drilling position can be selected. Generally, a seabed survey could be done using a remote-controlled, side-scan source. However, in adverse conditions, a diver might be needed to physically investigate the site. In all cases, the drilling template must be set horizontally, on good firm seabed, in an area free of fault outcrops and where it could not be covered by sediment slumping.

A further hazard to drilling, particularly offshore, lies in the frequent presence of shallow gas pockets in the surface formations. This gas may blow out to the well bore while the surface or conductor holes are being drilled, if sufficiently heavy drilling mud is not used to contain it. Since a riser is not normally used when the first shallow hole is drilled, the gas may enter the water column and create a fire hazard. If sufficient gas is released, the buoyancy of the floating drilling unit could be effected.

The presence of these shallow gas pockets can be readily established by a high resolution seismic survey known as a "sparker" survey. If gas pockets are indicated, extra precautions must be taken with the mud and casing programs.

The Panel recommends that operators be required to undertake an extensive site survey of the seabed, including a seismic sparker survey, when investigating an area for a specific drilling location.

BIOPHYSICAL EFFECTS OF EXPLORATORY DRILLING AND SUPPORT OPERATIONS

Routine exploratory drilling and support operations have the ability to affect the biological and physical environment in a number of ways. Drilling requires the disposal of rock cuttings and used drilling muds, usually into the sea. Other wastes such as sanitary and domestic sewage are also discharged to the sea. Garbage and scrap are either incinerated or transported to shore for disposal. Occasionally, fuels may be accidentally spilled during operations or while being transferred from the supply vessel to the drill rig. Such discharges can degrade the quality of water, especially in areas where circulation is poor.

In addition, airborne and underwater noise from routine operations can effect birds and marine mammals, and rig lights can attract and disorientate birds. The establishment of a shorebase can effect the local environment.

In certain seasons or life stages, fish, birds and marine mammals are particularly susceptible to waste discharges, noise and other disturbances. Therefore, knowledge of their locations, habits and population sizes is essential for contingency planning and for designing effective mitigation measures.

Domestic Wastes

Chevron claims that domestic sewage is unlikely to significantly degrade the environment since the volume of sewage from a drill rig would be small, an estimated 20 cubic metres per day, and it would be treated before being discharged overboard. Once in the sea, it would be rapidly diluted and biodegraded. Other liquid wastes, such as "grey water", would also dilute quickly.

Chevron expects to incinerate all combustible garbage on board the drill rig and transport all metal noncombustible wastes to shore for disposal. **The Panel concludes, because of the relatively small volumes involved and the established procedures for dealing with them, that domestic sewage and solid wastes, if treated according to regulatory requirements, will not result in any significant environmental damage.**

Drilling Muds and Cuttings

Several intervenors were concerned that drilling muds and rock cuttings would affect marine organisms living in the water column and seabed sediments. Their concerns centered on the possibly acute toxic effects of heavy metals and hydrocarbons in the drilling wastes. Others were concerned about possible sublethal effects from long-term exposure to toxic chemicals found in these discharges, the possibility of benthic organisms being smothered by discarded drilling wastes, and the alteration of benthic habitat due to the accumulation of solid drilling wastes on the sea floor.

While some components of drilling muds and rock cuttings could be acutely toxic, dispersion and dilution would normally be sufficient to reduce the concentrations of toxic chemicals in the water column to near background levels within a short distance from the point of discharge. Therefore, they are not expected to pose any environmental problem unless they are discharged at a high rate for a long time in areas with poor water circulation.

Bioaccumulation of heavy metals and the cumulative and synergistic effects of various toxins found in drilling waste discharges were also issues of considerable interest. Available evidence suggests that excess bioaccumulation due to drilling muds is low, if it can be demonstrated at all, and would be of doubtful ecological significance. The large data base gathered from the North Sea and Gulf of Mexico suggests that the effects from the discharges of these wastes are usually local, temporary, and do not result in significant harm to marine organisms.

Nevertheless, some actions can be taken to further reduce potential harm without significantly effecting the drilling operations. The Panel believes that it would be prudent to take these actions to be absolutely sure of a minimal effect upon the environment.

Two components of drilling muds considered potentially harmful to marine organisms are hexavalent chromium and mercury, including methyl-mercury. Under normal circumstances, hexavalent chromium, originating from chrome or ferrochrome lignosulphonate drilling muds, is not present in amounts to cause concern because most of it is reduced to the less toxic trivalent chromium by the organic constituents found in drilling muds. Also, a chrome-free lignosulphonate drilling mud is now becoming available for use in drilling operations.

> **The Panel recommends that only chrome-free lignosulphonate be used for drilling muds in offshore exploratory drilling operations on the west coast.**

The only source of mercury in drilling muds is barite. Chevron indicated that large amounts of barite will be used in the drilling mud only if high formation pressure is expected or encountered. Nevertheless, the mercury in barite is not expected to constitute an environmental hazard because it occurs as an insoluble sulphide and is largely biologically unavailable. As a mitigative measure, Chevron stated that if barite were to be used in its drilling program, every effort would be taken to select a barite source containing the least metallic impurities.

The Panel recommends that the regulatory authority require industry to use only those drilling mud products with low to zero heavy metal content, and that industry routinely sample their supplies to ensure the approved standards are maintained.

The Panel believes that if the proposed coastal exclusion zones are adhered to, drilling will not occur in areas of poor circulation such as in sheltered bays. This, along with the Panel's other recommendations, should ensure that no significant damage to marine biota will occur from the discharge of exploratory drilling wastes to the sea.

The Panel has some concern about the possible use of diesel oil as a "spotting fluid" in water-based drilling muds. A diesel oil spotting fluid is sometimes used to free differentially stuck drill collars. This use could result in several cubic metres of diesel oil being discharged to the sea along with water-based mud discharges. The historical record indicates that such discharges are infrequent and small and, in general, do not constitute a significant environmental hazard although they may result in local, short-term effects. Nevertheless, their use should be avoided, and alternatives to their use are available.

The Panel recommends that, to reduce the need to use oil as a spotting fluid to free stuck drill collars, spiral or straight grooved drill collars be used for all drilling operations.

The Panel recommends that if oil must be used to free collars, mineral oil or another nontoxic type of oil be used.

Oil-Based Drilling Muds

Oil-based drilling muds are sometimes used for special drilling situations and are currently used on a restricted basis in offshore exploratory drilling off the Canadian east coast and in the Beaufort Sea. Oil-based muds offer several advantages over water-based muds including improved protection if producing oil or gas formations are encountered, improved hole stability in formations subject to swelling, better lubrication and penetration rate, and superior hole stability in the drilling of deviated wells. However, oil-based drilling muds have the disadvantage of being more harmful to the environment than water-based muds.

Although Chevron does not intend to use oil-based muds for drilling in the Queen Charlotte Sound — Hecate Strait area, the Panel realizes that in certain drilling situations their use may be requested. Current regulations in Canada prohibit the marine disposal of diesel oil-based muds, and require a closed mud system if oil-based muds are used. However, formation cuttings contaminated with oil from oil-based muds can be discharged directly to the sea and some intervenors were concerned about possible harmful effects of this practice.

The Panel believes that oil-based drilling muds should not be used on the west coast except in circumstances where their use would have clear and significant advantages. Furthermore, the Panel believes that if oil-based drilling muds are to be used, mineral oil-based muds would minimize negative effects should these muds be accidentally released to the environment.

The Panel recommends, under special circumstances requiring the use of oil-based drilling muds, that:

1. **only mineral oil-based muds be used;**
2. **a closed system be used in which no oil-based drilling muds are released into the sea; and**
3. **the amount of oil adhering to the cuttings be minimized by jet washing at the shale shaker and by collecting the oil.**

Minor Spills

Offshore drilling operations require the transportation of supplies from the shorebase to the drill unit. These supplies include fuels, lubricants, drilling fluid additives, chemicals, cement, food and other materials and supplies. Spills could occur during the transfer of these supplies from the shorebase to supply vessel or from the supply vessel to the drill rig. The effects of these spills would depend on the volume and nature of the substance spilled and the presence of vulnerable marine species. In general, spills in the open sea should be less hazardous than spills in sheltered areas, such as bays and inlets and the shorebase site. Open sea spills should dilute quickly and not leave persistent concentrations. However, fish, birds or marine mammals could be harmed if they are present when the spill occurs and if the spill contains a toxic substance.

> *"I guess my concern is not the big oil spills, or the big things that might be happening. It's the small things, like what kind of chemicals . . . in your drilling operations, and the small spills, they would be more dangerous to the young salmon as it's going out to the ocean." (Clarence Martin, Waglisla, November 1984)*

The Panel recognizes that there is always a potential for relatively small spills of fuels and drilling supplies to occur. However, if these spills take place well offshore and away from sensitive areas, it is unlikely that they would cause major environmental damage. **The Panel believes that if industry has spill prevention and cleanup equipment on hand during all toxic substance transfers and if government regulations concerning such activities are followed, the risk to the environment will be minimal.**

Underwater Noise

Noise from drill rigs and support vessels is unavoidable in exploratory drilling and support operations.

Since marine mammals depend on vocalization and hearing for communication, locating prey and orienting themselves, concerns were expressed that noise from the drill rig or supply vessels could cause them to alter their behaviour or distribution.

Drill rig platform noises are loud, but they do not transmit readily into the water. The resulting underwater noise is judged to be less than that produced by regular shipping traffic or fishing boats. **The Panel concludes that the effects of underwater noise from the drill rig and support operations on marine mammals will be minimal.**

Several intervenors raised the possibillity of underwater noise affecting herring spawn. **The Panel believes that, if the recommended coastal exclusion zones are adhered to, the impact of underwater noise on herring spawn will be negligible.**

Airborne Noise

Some intervenors expressed concern that aircraft noise would have a greater effect on birds and some marine mammals than drilling operations and supply vessel traffic. Birds are most susceptible to aircraft noise particularly from helicopters near breeding areas. In Alaska, where most of the observational work has been done to date, cliff nesting seabirds fled en masse from their nesting sites when a helicopter approached within 180-250 m. Such panic can lead to catastrophic losses of eggs and chicks.

On the British Columbia coast, this threat is less significant owing to the relatively small numbers of cliff-nesting seabirds, primarily pelagic cormorants and common murres. Most of British Columbia's seabirds nest in burrows. This presumably buffers the intensity of the aircraft noise, but no direct observations have been made, and no systematic observations have been made of burrow-nesting seabirds either leaving or remaining in their burrows because of aircraft disturbance.

Whales, seals and sea lions also show disturbance responses to airborne noise. Although knowledge is sparse in this area, overflights seem to disturb marine mammals less than circling and repeated flights. The degree of habituation of mammals to airborne noise is largely unknown. Seals and sea lions are especially vulnerable to disturbance during pupping. When disturbed by low flying aircraft, harbour seals will vacate beaches leaving pups behind and will often fail to return to the same part of the beach. This can result in high pup mortality.

The Panel concludes that airborne noise, particularly from helicopters, could have a significant impact on breeding and nesting birds and on some marine mammals.

> **The Panel recommends that, to minimize disturbance to marine mammals and birds from aircraft noise, the Canadian Wildlife Service of Environment Canada and the British Columbia Ministry of Environment develop guidelines to prevent disturbances to sensitive species, and that these guidelines be followed by aircraft operators involved in the west coast offshore exploration program.**

The Panel suggests that these guidelines should be similar to those presently in use in the Beaufort Sea, and include the following major points:

- sensitive bird, seal and sea lion areas such as feeding and breeding locations should be mapped and critical seasons noted;
- major bird flight paths should be mapped so that helicopters and other aircraft can avoid these areas as much as possible;
- an aircraft exclusion zone with vertical and horizontal boundaries of at least 500 m from the sensitive areas should be maintained; and
- shorebases that generate aircraft noise (i.e. seaplane bases or helicopter pads) should be located away from biologically sensitive areas.

The Panel believes it would be unreasonable to limit aircraft constraints only to the oil and gas industry.

> **The Panel recommends that Transport Canada develop a mechanism to ensure that flight constraints around sensitive marine mammal and bird areas be applied to all aircraft operators in the area.**

Drill Rig Lights

Several intervenors expressed concern over the possibility of bird kills caused by attraction to drill rig lights. Lights from various types of man-made structures are known to attract and confuse birds. In North America alone, millions of land birds reportedly die annually from collisions with lights. The problem appears to be most acute during overcast skies when the celestial navigational cues for migrating birds are obscured.

Most of the one to two million seabirds found along the west coast are nocturnal, remaining on the ocean during daylight and flying to and from their burrows during twilight and darkness hours. Of these, alcids and petrels are known to be attracted to artificial lighting at night and the early Haida used to catch sea birds by attracting them with large bonfires. A number of studies have dealt with seabird mortality associated with ships and lighthouses, but few directly implicate offshore drill rigs. No formal studies have been conducted in the region.

In view of the uncertainty about the effects of rig lights on birds and the absence of firm evidence applicable to the west coast, the Panel concludes that there is a potential for bird kills to occur as a result of their attraction to rig lights and that some species on the west coast may be particularly susceptible because of their nocturnal habits. Impacts might be mitigated by shielding rig lights and by using blue light or strobe lights, providing these measures meet government safety lighting and navigational requirements, and satisfy operational requirements.

Drilling Unit at night

The Panel recommends that:

1. **where feasible, drill rig marking lights consist of high intensity strobe or other types of intermittent lights;**
2. **working lights be masked or shielded to minimize outward illumination; and**
3. **the attraction of birds to rig lights be monitored and reports published monthly on bird kills so that data is collected to better evaluate and mitigate potential problems.**

Shorebases

A shorebase facility will be required to support offshore exploration. Possible environmental impacts from shorebases could include disturbances from air and marine traffic and accidental spills. **However, the Panel concludes that as long as industrial zoned areas are used and good environmental design requirements are complied with, significant environmental effects are unlikely.**

> **The Panel recommends that during the exploration phase of offshore oil and gas activity, shorebase facilities be developed within the industrial zones of existing communities.**

Seabed Obstructions

After drilling has been completed, the Canada Oil and Gas Lands Administration Drilling Regulations require the seabed to be cleared of any material that could interfere with other marine users, and the Fisheries Act prohibits dumping of any debris on the sea floor.

Current Canada Oil and Gas Lands Administration regulations also require that the wellhead be cut at least one metre below the mud line. This requirement appears to be based on the assumption that the seabottom everywhere is relatively stable and not subject to scour or erosion. Chevron's Initial Environmental Evaluation and anecdotal information provided at the hearings indicated that sediment could be moved by current scour, particularly over shallow banks in Queen Charlotte Sound.

The Panel concludes that the wellhead cut-off distance below the mud line should depend on the potential for long-term sediment removal at any particular drill site.

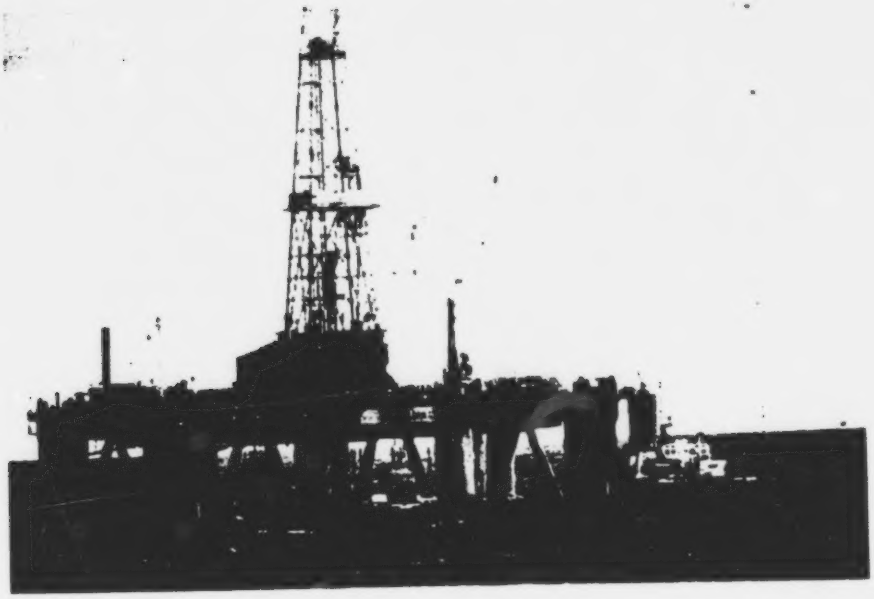
> **The Panel recommends that where sediment removal processes are evident at a drill site, the wellhead cut-off point below the seabottom be increased to three metres.**

Exploration Operations and Shipping

Marine traffic in the region is relatively heavy and includes deep sea traffic from Prince Rupert and Kitimat through Dixon Entrance and Hecate Strait and coastal traffic consisting of tugs, barges, ferries, cruise ships, freighters, fishing boats and recreation vessels. This marine traffic is expected to increase as Prince Rupert port facilities grow.

The increased traffic, in a region noted for its severe weather and poor visibility, will increase the possibility of collisions with fixed drilling units. At the present time, the Canadian Coast guard does not have in place a marine traffic management system for the exploration region.

The Panel recommends that the Canadian Coast Guard closely monitor any increase in ship traffic and, if and when offshore drilling is approved, develop and enforce the use of a marine traffic management system in the region.



Semi-submersible drilling unit

7. SOCIO-ECONOMIC EFFECTS OF ROUTINE OPERATIONS

As a new industrial activity on the British Columbia north coast, offshore exploration could have both positive and negative socio-economic effects on area residents. This section considers these effects.

During the first years of exploration activity, the pace of drilling activity is uncertain and its level varies from year to year.

In evaluating possible socio-economic effects of exploration, the Panel has considered the full period from initial exploration through delineation. During the early stages of an exploration program such as Chevron proposes, socio-economic effects would be minor. However, they could intensify as exploration increases. It is also possible that exploration activities could cease entirely if drilling results were not promising. The Panel has considered both possibilities.

In developing its conclusions and recommendations, the Panel operated from four basic principles:

(i) existing social structure, culture, lifestyle and traditional authority within communities should be supported;

(ii) adverse effects such as social disruption, inflation, and boom and bust cycles should be minimized or avoided;

(iii) local benefits associated with exploration, such as employment and business opportunities, should be maximized; and

(iv) a decision-making role should be provided for area residents in the management of offshore petroleum exploration.

MANAGING SOCIO-ECONOMIC EFFECTS

Intervenors expressed concern about the socio-economic effects which might result from offshore exploration. Area residents clearly perceived that this activity could bring large changes in their way of life. Some residents saw these changes as positive, through the stimulation of economic development and its potential for job creation and business opportunities. Others saw these changes as negative.

VULNERABILITY TO SOCIO-ECONOMIC EFFECTS

Many coastal communities have a limited range of economic opportunities and incomes fluctuate widely from year to year. Unemployment levels are high. While the area has witnessed the emergence and decline of many site-specific resource developments, there is relatively little experience with major area-wide activities such as offshore petroleum operations.

Residents of the region are vulnerable to environmental impacts. The lifestyle, culture, economy and social structure of the region is based mainly on its marine resources, particularly commercial fishing, domestic harvesting of marine resources, sport fishing and outdoor recreation. Added to these could be further development of tourism and mariculture which depend upon a clean and unpolluted natural environment. Residents are concerned that major damage to this environment would be inevitable if oil and gas exploration were to take place, and would affect their lifestyle, health, livelihood and the survival of communities with long standing cultural traditions.

Many residents were attracted to and remain in the region because of its wilderness character. Outdoor recreation is an important amenity for them. Most outdoor recreation activities in the region occur in the nearshore areas and along the shoreline where the abundance of birds, fish and marine mammals is important to the wilderness experience.

A perceived lack of influence in decisions affecting the area also contributes to a feeling of vulnerability on the part of many residents. Many people in the region argued that major resource decisions affecting them had been made in the past without their participation.

The Panel believes that means must be found to ensure that area residents have an effective role in decisions relating to the management of offshore exploration and its possible effects.

> *"The archaeological record of this area shows, one, a continual successful reliance upon sea resources; and two, the little ghost settlements littered all over the place of people who have tried to make their living through other means, homesteading, and raising a few cattle, or growing vegetables in the back garden; it doesn't work. So, really, it's only the fishing industry that makes sense here." (Jennifer Carpenter, Heiltsuk Band, Waglisla, September 1985)*

> *"It's our very deep concern in our village about the way that things are going now. Our life has been taken over by a higher power. We're not able to make our own decisions." (Marina Jones, Masset, November 1984)*

MONITORING AND SOCIO-ECONOMIC PROGRAMS

The socio-economic effects of offshore hydrocarbon exploration, such as employment and business opportunities, would increase as the level of exploration activity expands. However, the distribution and intensity of these effects could vary significantly among the communities of the region. Proximity to the area of activity, the availability of local skills, and the existence of alternate employment will determine the nature and extent of these effects.

A major concern expressed throughout the hearings was the unknown and unexpected cumulative effects of resource development activities within this region. Many participants felt that offshore oil and gas exploration, particularly during the early years, may not in itself have many negative effects. It could, however, in combination with other activities that would take place within the same region over a period of time, contribute to more significant cumulative effects.

Since area residents will experience the socio-economic effects of offshore exploration, they are the most authoritative source of information about these effects and their positive or negative influence on communities. During the hearings, participants expressed the view that socio-economic information about their communities collected by outside agencies was either inaccurate or incomplete. It, therefore, seems appropriate that communities be assigned the major role in monitoring the socio-economic effects of offshore exploration and designing appropriate measures to mitigate or control these effects.

The ability of communities to monitor socio-economic effects and respond to major changes will be influenced by the level of resources available to them. However, at the present time, communities within the region lack these resources.

The Panel concludes that to adequately understand the socio-economic effects which might arise from offshore exploration activities, these effects must be monitored and communities should play the major role in the monitoring program.

The Panel also concludes that some assistance must be provided to communities to undertake this important function.

> **The Panel recommends that, in the event of expanded exploration, the Department of Indian Affairs and Northern Development and the British Columbia Ministry of Municipal Affairs provide funding and other assistance to potentially affected communities so that these communities can initiate ongoing monitoring programs related to the socio-economic effects of offshore hydrocarbon exploration and initiate programs to deal with these effects.**

EXPECTATIONS

Whether expected changes occur or not, the perceptions of residents will have an effect on their actions. If these perceptions are too optimistic, residents may prematurely train for jobs or invest in business ventures. If they are too pessimistic, they may over react to small changes or live in anxiety about changes which never happen. By providing information on current and proposed activities of the petroleum industry, residents would be able to realistically adjust their expectations and plans. **The Panel concludes that public information and education programs are essential prior to, and during, offshore exploration activities.**

> **The Panel recommends that a public information and education program be initiated immediately through consultation with area residents, industry and the regulatory authority.**

> *". . . well, I would like to see a lot more local involvement. We have lifetimes of experience in our own area and I think that a lot more, you know, information could be gathered at the local level, for one thing . . ." (Lynn Hill, Hartley Bay, November 1984)*

> *". . . I strongly oppose any drilling, anywhere near where I live, far away or near. I strongly oppose it, just for the simple reason I made a statement here. I'm scared. I don't know what I'm going to get into . . . " (Ernest Jackson, Kitkatla, November 1984)*

> *"We are anxious . . . to ensure that the people of the area get the right information rather than the wrong information. And I believe we are committed at this point to a very open communication with all levels of public throughout the entire program." (Pat Haines, Chevron, Alert Bay, September 1985)*

REGIONAL ECONOMIC BENEFITS

Some participants were optimistic that offshore hydrocarbon exploration could result in an important diversification and expansion of the north coast economy. However, intervenors stated that exploration activities should not be carried out in a way which might jeopardize current and future renewable resource development activities.

Under existing Canada Oil and Gas Lands Administration procedures, a Canada Benefits Plan forms part of an Exploration Agreement with an operator. Under this Plan, the operator is encouraged to meet certain targets for Canadian, but not necessarily local, employment and purchasing. The British Columbia Ministry of Energy, Mines and Petroleum Resources endorsed the principle of maximizing local economic benefits.

The Panel concludes that although some long-term benefits might follow from expanded exploration, the employment and business opportunities during initial exploration would be few and short-term in nature. Most of these benefits would accrue to the shorebase community. As exploration expands, regional economic benefits would likely increase and securing local economic benefits would become a priority. Further, government and industry should ensure that area residents have a realistic understanding of the limited economic opportunities of an initial, small scale exploration program.

EMPLOYMENT

Some local residents expressed interest in exploration-related employment opportunities. They stressed the need for employment given the present high unemployment rates on the north coast and the limited alternative sources of employment. However, it is clear that only subsequent to a commercial discovery would a number of additional jobs of a permanent nature be created.

Typically, exploration activities are handled by contractors who bring in equipment and their own highly trained crews. Nevertheless, some jobs at the shorebase, on supply boats or on the drilling unit would be unskilled or entry level positions which could be filled by local residents. There could also be some additional employment with local businesses involved in supplying goods and services to the exploration operations. Chevron estimates the total direct, indirect and induced employment during initial exploration would be no more than 50 person-years, mostly in the form of temporary jobs. In addition, it is unclear whether Chevron or its contractors would give preference to local residents for available jobs.

"Offshore exploration and development must be conducted in a way that recognizes the economic importance and the need to preserve and protect other economic activities such as commercial fishing and tourism." (Alderman Detlef Beck, District of Kitimat, Kitimat, September 1985)

The Panel concludes that, as a basic principle, local employment benefits should be maximized. On this basis, the Panel believes it is essential that government and industry find ways to ensure that area residents have priority for exploration-related jobs.

The Panel recommends that, as a condition of obtaining an Exploration Agreement, an operator establish a preferential hiring policy for employing local residents assuming equivalent skills, and that the operator ensure contractors follow the same policy.

". . . I think there shouldn't be unrealistic expectations of the employment opportunities, and certainly not so in the areas of special skills, unless people are already in the area with those skills". (Bob Durie, MEMPR, Victoria, October 1985)

> *"The Canada Oil and Gas Lands Administration asks that a certain portion of the workforce and a certain portion of the monies be Canadian or from Canada. We do not demand they come from any special region, but we suggest that they hire locally, and many of the companies have worked out excellent programs to so do." (Bob Hornal, COGLA, Alert Bay, September 1985)*

Training

Some residents suggested that training should be available to enable local residents to compete for employment. However, given the few unskilled, entry-level jobs available and the uncertainty and limited scale of Chevron's initial exploration program, it would not be advisable at this time for local residents to train for skilled career jobs in the offshore petroleum industry.

However, the number and duration of jobs could increase for local residents if promising drilling results lead to expanded exploration. Various industry training courses are available for petroleum-related jobs and some training can be accomplished on-the-job. In addition, certain programs, such as Marine Emergency Duties Training, could be incorporated into existing community or technical college programs in British Columbia.

> **The Panel recommends that government and industry review existing training programs, and if exploration activity is expanded, implement training to enable local residents to qualify for offshore petroleum-related jobs.**

Competition for Skilled Workers

Experience elsewhere suggests that some shortages of workers with particular skills or trades could develop if employees of local businesses are hired for exploration-related work. This is particularly true where the exploration activities coincide with the prime seasons for local industries such as fishing, forestry and tourism. However, it seems unlikely that this problem would develop during the initial exploration period. The limited number of temporary, unskilled jobs created by offshore exploration would probably not be attractive to those who already have full time employment in skilled trades. However, if exploration expands, competition for certain skilled trades could occur.

Traditional Lifestyles

During an expanded exploration phase, employment opportunities might be available to local residents of the smaller communities in the region. Offshore petroleum workers usually work for several weeks, followed by several weeks off. In northern Canada, the oil industry has been successful in allowing people to supplement traditional resource harvesting with employment income by measures such as local training programs, on-the-job training, job sharing and flexible work schedules.

> **The Panel recommends that industry, in an expanded exploration program, develop programs in consultation with area residents that would enable them to pursue, as far as possible, traditional activities while employed in offshore exploration.**

LOCAL PURCHASING

Purchasing goods and services to support offshore exploration would begin during seismic exploration and increase as exploration activities expand. However, during the initial small-scale exploration program proposed by Chevron, local purchases of goods and services would be limited. Local businesses could supply accommodation, food and ground transportation for crews during work crew changes and supply food to the crews of the drilling unit, vessels and shorebase. They could supply industrial materials such as fuels, lubricants and drilling supplies to exploration contractors. It is also possible that they could operate supply vessels, work boats and helicopters.

Businesses within the region were interested in obtaining contracts to supply offshore activities, but were concerned that local suppliers might be overlooked or unable to compete with experienced world-wide suppliers. They suggested that local suppliers be given preference in the awarding of supply contracts.

The Panel concludes that in keeping with the principle of maximizing benefits to local residents, every effort should be made to facilitate participation by local businesses in supplying goods and services.

> **The Panel recommends that, as a condition of obtaining an Exploration Agreement, an operator establish policies giving preference to local suppliers of goods and services, and that the operator ensure contractors follow the same policy.**

COMMUNITY EFFECTS

The initial few years of exploration should not result in significant change in size, composition or distribution of the population within the region since offshore exploration would depend mainly on non-resident workers who are transported out of the area when their duty tour is completed. However, as exploration expands, there could be some changes in population which could lead to increased demands on community services and infrastructure, particularly in the shorebase community.

COMMUNITY SERVICES

Offshore exploration is one of several developments completed, underway or proposed for the area such as the LNG terminal, grain terminal, northeast and northwest coal. These projects affect primarily the Prince Rupert area. Some participants indicated that, as a result of these developments, unskilled youth have moved to the Prince Rupert area in the hope of finding work. Many are unemployed and this has increased the demands on local social assistance agencies. Relative high unemployment rates across British Columbia, combined with unrealistic employment expectations related to offshore exploration, could lead more people to move to Prince Rupert. In other regions where major resource developments have taken place, public information programs and hiring policies have been designed to discourage this phenomenon. Communities should monitor inmigration and, in cooperation with government and industry, institute similar programs and policies as required.

There could also be some redistribution of population within the region, especially in response to expanded exploration. Young people might move from smaller coastal communities to the shorebase community to take jobs with industry. This could result in the loss of population, and reduce the funding available for infrastructure and services in these communities, ultimately effecting their social stability and viability. Communities should monitor these movements, and if necessary, develop strategies for mitigating their effects, in cooperation with government and industry.

INFRASTRUCTURE

Chevron indicated that Prince Rupert should have adequate facilities to meet its dock, warehousing and yard requirements. In addition, exploratory drilling operations might require a number of local services, including water supply, wastewater treatment, solid waste disposal, disposal of drilling wastes, and road, rail and air transportation. However, should exploration lead to development, the supply base and terminal would doubtlessly be reestablished elsewhere on the coast. Production shorebases are usually established in conjunction with a pipeline landfall, terminal and administrative headquarters.

Port Simpson

"... would the smaller centers then have to lose population to the urban centers where the only employment would be created, and would that in fact not make them less viable? You need a certain number of people to maintain a school, to maintain the services that make this a viable community, and it's not a community only ..." (M. Anderson, Hartley Bay, November 1984)

The demands on community services and infrastructure of the shorebase community during exploration should be minor. Chevron stated that most of its exploration workforce would not live at the shorebase community, so there would be few additional demands for community services during exploration. There could be an occasional demand for hospital services for crew injuries, a few demands on community services if workers remain in the shorebase community between shifts and some increased demands on the Prince Rupert airport to transport exploration workers home.

Demands on the infrastructure and services of other communities would be negligible. Port Hardy and Sandspit, as possible emergency helicopter landing sites, might require some upgrading of their facilities. In addition, there might be sites along the coast where oil spill cleanup equipment would be stored. The operator would likely be required to provide the necessary services for these sites.

East side Graham Is, Queen Charlotte Islands

8. HYDROCARBON BLOWOUTS

Public concern during the review was most intense with regard to the possibility of a major oil blowout. The Panel acknowledges this concern, and agrees that the impacts from such an accident would pose the greatest potential environmental threat associated with offshore exploration for oil and gas.

In this section, the Panel discusses the causes of blowouts, the technology used to prevent them and the incidence and probabilities of blowouts. Recommendations are designed to reduce occurrence and mitigate impacts.

WELL CONTROL TECHNOLOGY

Well control is achieved by the weighted column of in-hole drilling mud. If mud column control deteriorates, threatening a blowout, the blowout preventer stack mounted on the wellhead at the seabed provides a fall-back level of protection.

THE MUD SYSTEM

If sufficient pressure is not maintained [illegible] a porous and permeable formation being drilled, the pressured fluid it contains (gas, oil or water combinations) will enter the well bore and flow to the surface. The normal method of maintaining control pressure is to provide a full column of mud in the well bore to exert sufficient excess pressure at the formation face. This overbalances the natural pressure in the formation and holds any fluids within that formation in place. Drilling muds can range in specific gravity and composition from almost water right up to very heavy mud with a specific gravity of 2.0 or more. Drilling mud contains bentonite in colloidal suspension plus weighting material such as barite, and other additives for particular properties.

Loss of overbalancing pressure from a column of drilling mud can occur in one of two ways.

First, the bit can penetrate an unexpectedly high-pressure, porous and permeable formation, the fluids from which can lift the mud column, expelling it from the hole. This is a rare phenomenon, since even in virgin exploration areas, pressure characteristics are generally well known from the regional geology, and drilling muds and casing programs are designed accordingly. Certainly on the west coast, regional formation pressure characteristics are well known, and mud and casing programs would be tailored for these characteristics. If loss of control is threatened due to higher than anticipated pressure in the formation being drilled, extra weight would be added to the mud to counter that pressure.

Beach cleanup, Alert Bay spill

> *"to stand there in the almost dark of the early morning and see this black horror just silently coming in, everybody's busy about the early morning duties, nobody aware of that horror that was slowly, quietly washing right in. And it was relentless, you can't stop it when it comes, the tide just brings it in. And it spreads and spreads and spreads, and it's a horror, but it worried me, was what I saw afterwards, what was washed up afterwards, the dead and the sea birds." (Dorothy Shuker, Alert Bay, November 1984)*

Loss of overbalancing pressure can also occur if the bit penetrates a low pressure "leak" or "thief" zone, which carries the mud away into the formation. Loss of circulation occurs as annular mud stops returning to the surface. Column pressure is reduced allowing higher pressure hydrocarbon fluids from other zones into the well bore and up the hole, lifting the remaining mud out. If the mud volume is being lost to a thief zone, the zone can be sealed by circulating additives in the mud such as walnut shells, shredded tires, or grain husks. The column is then built back up to prior volume, properties and required weight.

Even if the column is lifted out of the hole, this does not necessarily spell disaster.

THE BLOWOUT PREVENTER STACK

Should the mud system fail to maintain sufficient overpressure to contain the flow of hydrocarbons into the well, the blowout preventer (BOP) stack affords a further line of defence. The blowout preventer stack is mounted onto the smallest casing at the wellhead on the sea floor.

Preventers are designed to afford either an annular or open hole seal. Once closed, they are designed to withstand all subsequent hole pressure. They are controlled from the floor of the drilling unit by the driller actuating high hydraulic pressures through small pipes to the stack. A complete, redundant set of actuation equipment is provided for safety. BOP assembly and operation is described in greater detail in Section 6.

If a blowout occurs and control cannot be regained through use of BOP's and mud, well blowout specialists may be needed to implement special procedures or to install special equipment which may aid in reducing the flow, or in killing the well. In certain circumstances, control of wells may be regained when the well bore becomes naturally clogged or "bridged" by debris or rock. If all other means fail, it will be necessary to drill a relief well.

RELIEF WELLS

Since the exact trace of the exploratory well is always carefully surveyed for depth and position, it is possible to bring in a completely equipped drilling unit from elsewhere, place it in a safe position near the blowing well, and by directional drilling, drill a new hole that will intersect the original well at or near its entry into the high pressure blowing formation. Heavy mud and cement can then be injected through the relief well to kill the blowing well. Relief wells take considerably more time to drill than the original well.

Chevron stated it would take 7 to 14 days to mobilize a relief well drilling unit and to get it into place, depending on immediate availability and an average transit speed of 5 to 6 knots.

The Panel believes that formal arrangements must be in place to guarantee that a relief well drilling unit is available and can be positioned at a blowout site within a set period of days.

> **The Panel recommends that the regulatory authority not approve the drilling of any exploratory well until the operator has proven that formal arrangements are in place to bring in a relief well drilling unit to a blowout site and begin drilling a relief well within 14 days of a decision to mobilize, regardless of inclement weather or other inhibiting factors. The arrangements to start mobilizing a relief well unit are to be put into action within 48 hours of the start of a blowout.**

INCIDENCE AND PROBABILITY

Major well blowouts are rare events. Thousands of wells have been drilled offshore in all parts of the world for exploratory, delineation and development purposes. Statistical incidence of oil blowouts in all types of wells is approximately 1 in 3,000. When they do occur, the volumes of oil released are usually small.

Blowouts occur because of human failure or human induced equipment failure. As previously described, modern drilling equipment is designed with back-up safety systems and significant safety margins. Equipment failure usually occurs because of improper installation, inspection, maintenance or use.

Studies confirm that most blowouts occur because of human failure. They are usually caused by human hands doing the wrong thing either inadvertently or in panic, by human minds not planning adequately or competently, or by human beings taking unacceptable chances through laziness or complacency. In itself, equipment rarely fails. Sometimes personnel are poorly trained or selected, or lack the experience, knowledge or aptitude to respond appropriately to risks or to install, operate or maintain equipment effectively. Management and supervision, or the enforcement of government regulations, may be inadequate.

The Panel concludes that the possibility of a blowout can best be reduced by paying strict attention to the training, experience and competence of operators and regulators, and by using the best and latest equipment. Because of the gravity of a major accident, the regulatory authority should not assume that operators and drilling personnel are adequately trained and experienced, or that equipment is installed and used properly.

> **The Panel recommends that, before exploratory drilling begins, the regulatory authority take steps to:**
>
> 1. **directly assess the experience, training, testing, and supervisory capabilities of drilling personnel;**
> 2. **ensure the best quality equipment, meeting the toughest standards of design, is used in all drilling and well-control operations;**
> 3. **develop effective surveillance, inspection and enforcement programs and practices related to well control, and ensure that these programs and practices are carried out in a thorough and timely manner; and**
> 4. **ensure that programs include frequent, unannounced inspections and exercises to ensure that appropriate drilling procedures, standards and regulations are being met, and to verify that drilling personnel and equipment are prepared for responding to drilling emergencies and blowouts.**

GAS CONDENSATE BLOWOUTS

Although not as heavy as a mud column, an oil column in a well provides some measure of control over producing formations. Pressure is less than a column of water would produce but is nonetheless considerable. In a gas condensate blowout, however, the condensate is in gaseous form and only condenses to a liquid as its temperature and pressure reduces while rising in the well bore and at the surface. The column in the well, of mainly gas, exerts essentially no pressure on the producing formation. A gas condensate blowout, therefore, without column back pressure, occurs more suddenly and at a much faster rate than an oil blowout.

The liquids condensing are invariably very light alkane and aromatic hydrocarbon compounds. While these products are highly toxic to certain biota, they evaporate quickly. If the gas and liquids contain hydrogen sulphide, the resulting "sour gas" would be highly toxic to all forms of life, and it is possible that the gas condensate outflow would have to be ignited. Other than this difference, an oil blowout (with gas) and a gas blowout (with condensate) are similar, particularly in terms of controlling and killing the well. Clearly, however, a gas blowout is far less harmful to the environment than an oil blowout.

TANKER SPILLS

An offshore oil blowout in which large quantities of oil are released into the marine environment clearly has serious consequences. A tanker accident resulting in a major oil spill would also cause tremendous damage. While there can be some similarities between these two types of incidents, there are also important differences, particularly during the initial days of the events. Oil blowouts release unweathered crude oil containing high pressure gas and all light ends. Oil carried by tankers has been partially processed to remove these gas energy light ends. Thus, oil from tanker spills behaves quite differently from fresh oil from a blowout. Oil from an oil well blowout would not produce the same slick thicknesses and concentrated volumes as an oil tanker spill. Oil from a tanker is viscous, slowly spilled and under no pressure, while oil from a blowout is usually ejected at steady rates, under high pressure, deep underwater, and in company with large volumes of gas. This results in turbulent mixing with the water column and thinner, more widespread slicks. Tanker accidents also often occur close to shore in unpredictable locations, whereas blowouts occur at selected well sites usually well offshore.

Because during the first few days of the event, oil from tankers and blowouts behaves differently, the types of environmental effect and the contingency and countermeasure strategies developed for responding to them will differ accordingly.

CASE HISTORIES OF REPRESENTATIVE BLOWOUTS

Only three significant offshore oil well blowouts have occurred: one off California in 1969, one in the North Sea in 1977, and one off Mexico in 1979. The California blowout involved a development well being drilled from a permanent production platform. The North Sea blowout involved a producing well on a permanent production platform. The Mexican blowout occurred during delineation drilling using a semi-submersible. Brief capsule descriptions of these incidents are given in the boxes to illustrate how blowouts can occur and what volumes of oil may be released.

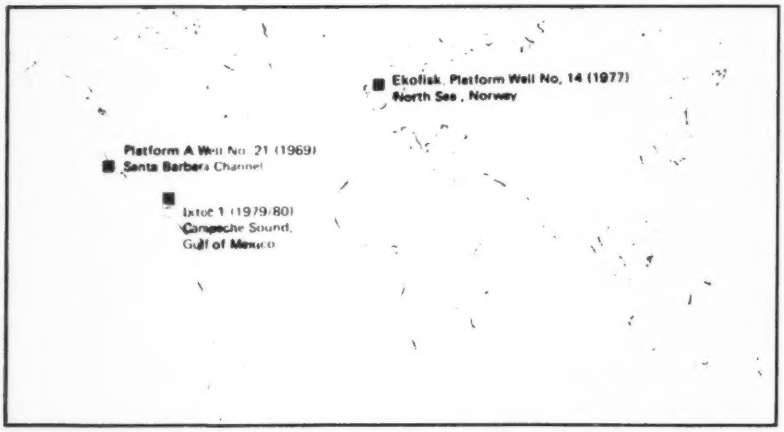


Figure 9: Location of Representative Actual Blowouts

PLATFORM A, WELL NO. 21, SANTA BARBARA CHANNEL, CALIFORNIA, 1969

A routine development well was being drilled off Union Oil Company's permanent Platform A near Carpenteria, California in 57 m of water. The well was at 1044 m depth when a blowout occurred. Conductor casing of 340 mm (13 3/8 in) diameter was cemented at 71 m below the sea floor. Drill pipe was being pulled when a mud and hydrocarbon mist started to flow from the wellhead. The blowout preventer valves were at the platform level, not the sea floor. Blind rams were closed to shear the drill pipe and it dropped into the hole within 15 minutes of the start of the blowout. Pressure was relieved to formations at the sea floor surface around the hole in view of the shallow casing depth, and oil and gas immediately broke out on the sea floor around the well. The dropped drill pipe was fished and reconnected by snubbing under pressure through the blowout preventer stack, and heavy mud injection reduced the flow. When the sea floor bubbles were reduced to almost nothing, the well was cemented. This was on the 12th day after the blowout.

Further seepage occurred thereafter. This seepage was eventually controlled by drilling out cement, reinjecting mud and cement and putting neighbouring wells and the blowout well into production to draw down pressure. However, some seepage occurred for a further four months. About 60,000 barrels were lost in total and a large slick formed. Ten kilometers of shoreline were eventually fouled. The blowout was initially gaseous and eventually mostly oil. A relief well was not necessary and probably not feasible.

This accident occurred during early days of offshore drilling and led to major changes in design and practice. These changes include the use of deeper and improved casing programs.

EKOFISK PLATFORM, WELL NO. 14, EKOFISK FIELD, NORTH SEA, NORWAY, 1977

This producing well was being prepared for repair after a drilling fluid column had been introduced to kill the well. When the well was apparently dead under the mud column, the main producing valve assembly or "Christmas Tree" was removed, and a single pipe ram production BOP installed. The well immediately began to flow oil and gas through the preventer. Unfortunately, rams in the preventer were the wrong size for the pipe quickly introduced into the hole, and the preventer had been installed upside down, hindering kill attempts. Eventually, the well was brought under control eight days after the blowout. The blowout period coincided with adverse weather conditions, which made access to the rig difficult. About 160,000 barrels of oil were sprayed onto the North Sea and little of it was recovered. The operator stated that at least 50% evaporated within 12 hours of the spill. A large slick was formed. A relief well had been planned but was never started.

This accident occurred because of the incorrect use of equipment, including the improper installation of the blowout preventers and the use of wrong sized rams. Response to the blowout was complicated by poor weather conditions.

IXTOC 1, CAMPECHE SOUND, GULF OF MEXICO, MEXICO, 1979-80

The only major oil blowout to occur from a semi-submersible unit drilling an exploratory type delineation well occurred on June 5, 1979. It was an exceptional occurrence, being by far the worst ever marine oil blowout. It was not brought under final control until March 25, 1980.

The SEDCO 135F semi-submersible drilling unit was drilling on June 3 at 3,657 m with 244 mm (9 5/8") production casing cemented at 3,627 m. The blowout preventer stack was in place on the sea floor in 52 m of water. Drilling fluid circulation was suddenly and totally lost and two days were spent in carefully trying to regain it with appropriate drilling fluid materials.

At this time, the drillstring was pulled, but when drill collars had been brought to BOP level, flow began. Bag-type preventers were closed around the collars, flow increased inside the collars, and the collars started rising from the well. Shearing of the thick-walled collars proved impossible; the flow ignited and the crew was evacuated. All of the standard drilling equipment collapsed; the drilling unit was pulled off and scuttled, but fortunately the blowout preventer stack remained intact on the seabed. A large fire continued to burn on the sea surface and reduced the volume of escaping oil.

A 60% water, 40% oil emulsion formed within 150 m of the fire. A one-kilometer wide band of oil, 1 to 3 mm thick extended 2 km downwind of the fire. About 30% of the oil was burned off. By June 12 a slick 180 km long and 80 km wide had formed and was moving west.

By June 26, some success had been achieved in actuating preventer valves when divers were able to attach some hydraulic hoses to the BOP's. A reduction in flow was achieved, but fluids immediately broke out around the wellhead on the ocean floor. It is believed that this happened because the string of cemented production casing may have ruptured at a shallow depth.

At this time, relief well drilling began. Concurrently, other methods of control were attempted to kill the blowing well. These resulted in a reduction in flow from 30,000 to 10,000 barrels per day. However, once fluid had broken out around the wellhead the only really positive method of control was a relief well.

Two relief wells were drilled, the second being successful. Drilling began on July 2 and the blowing well was intersected on November 20, 1979. After a long period of fluid injection into the relief well, Ixtoc 1 was finally brought under control on March 17, 1980. It was plugged and abandoned on March 25, 1980.

A total of 281 days elapsed from start to finish. An estimated 3.5 million barrels of oil were released to the sea.

Improper use of ram preventers and total reliance on bag preventers could have triggered this very serious disaster. Pipe rams are not designed to close off on drill collars and will not shear them, and fallback equipment was inadequate to provide a seal.

9. THE FATE AND EFFECTS OF OIL IN THE MARINE ENVIRONMENT

This section considers the patterns of movement and decay of oil slicks, the effects of oil on west coast marine life, including salmon, herring, groundfish, shellfish, birds and mammals, and the socio-economic effects of a blowout.

THE BEHAVIOUR OF OIL RELEASED BY BLOWOUTS

The behaviour of oil in the marine environment affects the nature of biological impacts resulting from an oil blowout. It also affects the success of countermeasure strategies and contingency plans.

When oil is released to the sea it undergoes complex physical and chemical changes such as spreading, evaporation, dissolution, dispersion, degradation and emulsion formation. The rate at which these processes occur depends on the type of oil and on the environment in which the blowout occurs.

TYPES OF OIL

Crude oil is composed of numerous complex hydrocarbon compounds of differing molecular weights and structures ranging from a light gas (methane) to heavy solids. Each crude oil varies in physical and chemical properties such as specific gravity, surface tension, viscosity, pour point, flash point and solubility.

Consequently, slicks of different oil types vary in their tendency to spread, move about, evaporate, dissolve, emulsify, oxidize and biodegrade. These characteristics determine the biological effects of the oil slick and influence the planning of countermeasures.

Chevron stated it is impossible to predict what type of oil might be found on the west coast in advance of a discovery. Therefore, the behaviour and fate of oil from a blowout occuring in the north coast region would be unpredictable.

INFLUENCES OF THE MARINE ENVIRONMENT

The spreading and movement of oil slicks is strongly influenced by surface water movement. On the west coast, surface water movement is affected by weather systems and storms from the north Pacific, which have a high incidence of gale force winds and high seastates. It is also affected by large tidal ranges, strong tidal currents and irregular coastlines. Air and water temperatures, water salinity and sediment loads also determine the physical and chemical behaviour of oil. For example, crude oil becomes more viscous and evaporates more slowly in colder water. This will affect its spreading and toxicity as well as the penetration of oil into shoreline sediments.

CONCENTRATIONS OF OIL IN THE WATER COLUMN

The effects of crude oil on fish, birds, marine mammals and other marine species depend on the concentrations of the oil in the water column after a blowout. Concentration depends on the type of oil and the chemical and physical processes that weather and degrade it.

Chevron stated that a blowout would produce a flow of hydrocarbons that would break into patches and become weathered within a few hours. The light hydrocarbon fractions would quickly evaporate or dissolve in the water column, rapidly reducing the toxicity of the oil. Chevron stated that slicks formed by a blowout would be very thin, averaging about 0.1 mm at 1 km from the blowout site, depending on the viscosity of the oil and confining shorelines.

Chevron cited experiments where concentrations of oil in the water column were measured before and after application of dispersants. Concentrations of one to two parts per million were measured in the water column. When dispersants were applied to disperse oil from the surface into the water column, the highest concentrations measured in the water column were 40 parts per million.

Chevron's position was disputed by other participants. The Department of Fisheries and Oceans argued that turbulent mixing and dispersion of oil could result in high concentrations in the water column of minute hydrocarbon globules consisting of mostly unweathered hydrocarbons. The Department also questioned Chevron's information about observed slick thicknesses and oil concentrations in water after a blowout.

From the information presented to the Panel, there is clearly little agreement on slick thicknesses or on the concentrations of oil in the water column that would result from a blowout.

> *"Depending on the type of oil and the ambient conditions, 25 to 75 percent of the crude oil typically evaporates within the first 12 to 48 hours." (Ted Spearing, Chevron, Victoria, October 1985)*

"... evaporation from oil is an exponential type function, which means if you lose 25 per cent in the first 24 hours, you're losing around nine per cent in the next 24 hours, and onwards down. So ultimately you would only lose relatively around 30, 40 per cent, right down to let's say one month." (Kim Roberts, Kwakiutl District Council, Vancouver, November 1985)

EMULSIONS

Some participants were concerned about the possible formation of water-in-oil emulsions, or "mousses." Mousses form as a result of the turbulent mixing of certain types of relatively high viscosity and high specific gravity oil into the water column. The turbulence can result from heavy wave action or from the gas flowing in the blowout plume, especially in shallow water.

Mousses can be very stable and may persist for months or years after a spill. The light ends of oil trapped within mousses do not evaporate readily. Mousses resist weathering and can drift long distances while retaining their toxicity. The Department of Fisheries and Oceans reported that mousses in layers up to one metre thick formed during the Ixtoc I blowout in the Gulf of Mexico, and drifted for several weeks before stranding on beaches over 500 miles away in south Texas.

On reaching the shore, mousses tend to pick up sand and debris and, once the water in them evaporates, they form lumps of tar which resist further weathering. Concern was raised that these tar lumps could result in the slow release of toxic oil over several years.

SINKING AND SEDIMENTATION

Unweathered crude oil is less dense than water and will float. However, as the lighter fractions evaporate and the oil is weathered, its density increases. After considerable weathering, some residual oils may sink below the sea surface. This is more likely to occur if the weathered oil adsorbs heavy particulate material in the water such as silt or clay, or if the slick spreads from denser sea water to less dense fresh water. Concern was expressed that sunken oil may poison, smother or displace seabottom and intertidal organisms.

STRANDING ON SHORES

The biological importance of shorelines and nearshore waters is particularly high because of the concentrations of juvenile salmon, herring roe, shellfish, birds and marine mammals. At the same time, oil tends to collect in higher concentrations on shorelines than open water because further movement and dispersion is impeded by the shore itself.

The effects of oil on the nearshore ecosystem depends on the type of oil and the degree of weathering it has undergone. Generally, a slick is less damaging the longer it has been at sea. Highly weathered oil may come ashore as individual tar balls, whereas fresh oil may coat the entire intertidal zone.

The effects of oil on shorelines also depend on the type of shoreline. Shores exposed to high wave energy usually do not retain oil for long. Wave and tidal action disperse the oil, allowing it to weather and biodegrade faster. On the other hand, sheltered areas such as bays, inlets, lagoons, marshes and pocket beaches retain oil longer due to the lower wave energy. In these cases, oil may be retained for years.

If the shores are steep, intertidal zones are relatively narrow. A broad intertidal zone with tidal pools may retain oil longer. If oil comes in on a high tide, it may be deposited where it can only be reached by the next high tide.

The material making up the shore also affects oil retention. Oil penetrates some materials more quickly than others, influenced by the viscosity of the oil, temperature, the permeability of the beach material and other factors. On exposed sandy beaches, for example, oil may be mixed into the substrate where it retains its toxicity and resists further weathering.

BIOPHYSICAL EFFECTS OF A BLOWOUT

In considering the effects of oil on fish, shellfish, birds and marine mammals, the Panel recognizes that research on these effects is incomplete. Oil in sea water has different effects on different species. Not all of these effects have been identified. In addition, individual species are often related to each other within the marine ecosystem in complex, poorly understood ways. As a result, an effect on one species usually has effects on other species. These effects can occur, for example, through the foodweb and predator-prey relationships. Therefore, while studies of the biophysical effects of oil tend to focus on individual species or groups of species, care must be used in applying these studies to the total marine environment.

EFFECTS OF OIL ON FISH AND INVERTEBRATES

The west coast supports large populations of salmon, herring, groundfish, shellfish and invertebrates. Effects of oil vary with species, type of oil and environmental conditions. Effects can include fish kills and sublethal effects such as reduced growth, developmental abnormalities, behavioural changes, and changes in reproductive potential. In the competitive natural environment, sublethal effects can affect the size and health of fish populations.

> *"But it is apparent that hydrocarbons can greatly reduce the individual's chances of survival; individuals make up populations, and accordingly, reductions in population size are of concern... It cannot be assumed that fish will avoid contaminated waters, and studies have demonstrated that fish do not necessarily avoid harmful conditions in their environment. Motivated fish, competing for food, avoiding predators or migrating in the natural environment may react quite differently to less stimulated and less motivated fish held under laboratory conditions." (I. Birtwell, D.F.O., Vancouver, October 1985)*

> *"... there seems to me to be a lot of data missing on the behaviour of oil and how it affects estuaries, how it affects migrating fish, how it affects fingerlings, the small fish fry that are in estuaries, and what do you do if this information isn't forthcoming." (Kevin O'Neil, Central Coast Fishermen's Protective Association, Bella Coola, November 1984)*

Salmon

The effects of oil on juvenile and adult salmon would depend on the concentrations of oil in the water column. Chevron stated that concentrations from a blowout would be unlikely to reach lethal levels. Many intervenors disputed this statement, arguing that likely concentrations of oil in the water would be lethal to salmon. The Department of Fisheries and Oceans argued that not all toxic components of the oil would evaporate, and that some of the remaining heavier fractions would still be toxic.

At present, much of the data on lethal concentration levels for salmon is based on a few experiments and limited field information. Given the wide divergence of opinion between Chevron and other participants, it is prudent to assume that oil could be toxic to fish at low concentrations. Since it is not known what those concentrations would be, the possibility that lethal concentrations of hydrocarbons would be present in the water column in the event of an oil blowout, and that fish would be affected, cannot be ruled out.

The Department of Fisheries and Oceans and other participants were also concerned about the potential for sublethal effects of oil on salmon. The presence of oil contamination when juvenile salmon enter the sea could affect their ability to make the adjustment from fresh to salt water. Exposure to oil might also affect the growth of juvenile salmon, rendering the fish more susceptible to predation and less able to compete for food.

There is reason to be concerned about the lack of knowledge concerning the lethal and sublethal effects of various concentrations of oil on juvenile and adult salmon. More information is required for contingency planning and fisheries management in the event of an offshore oil blowout.

> **The Panel recommends that the Department of Fisheries and Oceans conduct research to determine the lethal and sublethal effects of naturally and artificially dispersed crude oil on critical life stages of migrating salmonid species.**

Herring

Herring are at risk from a blowout because their spawning, incubation and nursery stages take place in nearshore waters where the risk of exposure to toxic concentrations of oil is high. Herring eggs are deposited on kelp, algae and rocks in shallow nearshore areas. The greatest threat would occur during their spawning and larval stages, particularly March and April. Exposure to oil at this time could cause mortality or abnormal development. The effects on the early life stages of a year-class of herring could have long-term recurring consequences on herring stocks.

Groundfish

Concerns were raised that the groundfish eggs and larvae could be affected by spilled oil. The eggs and larvae of several groundfish species float at or near the surface and drift with the current. As a result, they are vulnerable to oil floating on the surface or dispersed in the water column. The most sensitive period is during the reproductive months from January to September.

Sinking oil may also affect adult and juvenile groundfish that inhabit seabottom environments. Impacts could vary from lethal to sublethal effects such as reduced growth and other physiological changes. Food sources could be reduced or contaminated by oil. However, since groundfish inhabit seabottom environments, they would be less likely to be affected by oil drifting on the surface or in near-surface waters.

Shellfish and Invertebrates

Several species of shellfish and invertebrates are important to commercial fishing, the native food fishery and potential mariculture operations. These include shrimps, crabs, clams, abalone, scallops, mussels, oysters and sea urchins. At one or more stages in their life cycle, most invertebrates form part of the marine foodweb upon which other species, including commercial species of fish, depend. Many invertebrates live in surface waters early in their life. At this stage they are extremely sensitive to oil and could be exposed to oil slicks.

Invertebrates also occupy nearshore areas where they are vulnerable to oil. If these were contaminated, invertebrates may be killed, lose habitat or experience reduced food availability, contamination or tainting. Crab, shrimp, amphipods and other crustaceans are particularly sensitive to oil, especially during larval stages and moulting periods. A decline in crab populations has been noted in oil polluted waters. Clams, oysters and other bivalves exposed to oil have remained contaminated for up to a year.

Research on the Effects of Oil on Fish and Shellfish

There is considerable controversy about the effects of oil on fish and shellfish. In view of the economic and social importance of the west coast fishery, however, it is prudent to assume that an oil blowout could seriously damage the fishery and significantly reduce fish and shellfish stocks.

Because of the inherent limitations of laboratory experimental research in determining the effects of oil on marine species, knowledge to aid in assessing the effects of oil can best be obtained in actual field conditions. Unfortunately, the documentation of the biophysical effects of actual marine oil spills has often been poor, and the interpretation of case studies controversial.

Although further research on the lethal and sublethal effects of oil on salmon and other fish species at various life stages is useful, the Panel believes that concentrating on this particular data gap would be misleading because it is only one element of a range of data which is needed to develop comprehensive models of the potential effects of an oil spill on important fish species.

> **The Panel recommends that the Department of Fisheries and Oceans, in cooperation with other agencies, develop a comprehensive research program designed to reduce data gaps necessary to develop a credible model of the impact of an oil blowout on important fish species at their various life stages.**
>
> **The Panel recommends that, in the event of a blowout, the Department of Fisheries and Oceans be prepared to immediately initiate a major research and monitoring program to gather information on the actual concentrations of dispersed oil in the water column and the lethal and sublethal effects on important west coast species, particularly salmon and herring, at critical life stages, in order to assess more accurately the effects of oil on these species.**

At the same time, government and industry should continue to pursue present research programs on the effects of oil on fish and shellfish and to improve basic information on the fisheries resources of the west coast.

EFFECTS OF OIL ON BIRDS

Birds are the most conspicuous victims of oil slicks. When a large oil slick reaches an area with many seabirds, significant losses occur. The plight of oiled birds, and the inability to do much to clean them, is a source of strong public concern.

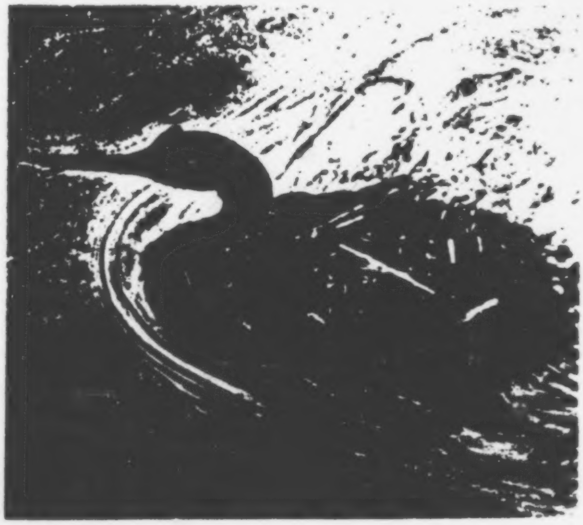
The most important factor leading to bird deaths is the oiling of feathers. Birds attempt to remove oil by preening their feathers. This mats the feathers and misaligns the feather barbules, allowing water to seep in and wet the underlying feathers and skin. As the bird continues to preen, more of its body becomes exposed. In the cold waters of the north coast, wet birds would lose heat rapidly, suffer from hypothermia, and die. Because a bird's primary form of insulation is penetrated, even a small amount of oil can, in some cases, result in sufficient loss of body heat to cause the bird to die.

Vulnerability and sensitivity to oil varies among species according to their habitat. Continuous swimmers, such as alcids and sea ducks, are likely to encounter oil if they are in the vicinity of a slick. By far the greatest proportion of Canada's west coast seabirds are continuous swimmers, except during the breeding season. Some species go through flightless periods on the water or migrate by swimming. These birds are poorly adapted to function out of the water and would not be able to forage or look after their young.

In addition to the effects of oil on waterproofing, oil may be ingested as birds preen their feathers. The effects of ingesting oil have been studied, but there is some controversy about its effect on survival. If incubating birds get oiled they may oil their eggs, reducing hatching success.

While there are concentrations of seabirds in offshore areas such as over upwellings and offshore banks, birds are most concentrated in nearshore waters. Although many seabirds spend most of their life at sea, several species concentrate in colonies during breeding season to produce their young, while continuing to forage at sea. A large proportion of the breeding population of several species may be found in certain colonies. These colonies are usually on exposed and isolated islands and shores, which are vulnerable to oil. Little is known about the offshore distribution of these birds outside the breeding season.

Many migratory birds use coastal migration routes in their spring and fall migrations, and use certain coastal areas as stopovers or staging areas. At these sites, thousands of birds may congregate to feed and rest. Some species spend the winter in the region. Birds in these nearshore locations are highly vulnerable to oil slicks.



Oiled bird

Intervenors and government agencies argued that more information is required on bird populations in the region. While the information base on coastal bird populations is expanding, information on certain species is lacking and many areas have not been adequately surveyed. Certain information is vital to contingency planning, such as which shore areas are used by birds during various stages in their life cycle. **The Panel believes that, prior to drilling, improved inventories of coastal bird populations are necessary for contingency planning purposes.**

> **The Panel recommends that, before exploratory drilling begins, Environment Canada (Canadian Wildlife Service), assisted by appropriate provincial agencies, undertake inventory surveys of the coastline of the region as well as adjacent shelf waters, to establish baseline information on the population, location and behaviour of coastal bird species for contingency planning purposes.**

Whenever spills occur, efforts are made by concerned individuals to help clean oiled birds. Athough this is done for humanitarian reasons, bird survival rates are usually low. In some cases, birds may actually suffer considerably from the cleaning effort, especially if skilled staff are not available to advise on the best methods, and to decide which birds should be treated.

> **The Panel recommends that the operator, as part of its oil blowout contingency plan, identify experts on bird cleaning who will be available on call to direct local efforts to clean oiled birds.**

EFFECTS OF OIL ON MARINE MAMMALS

Pinnepeds and Otters

Oil can affect pinnepeds (seals and sea lions) and otters in various ways. Physical contact with oil can irritate or damage sensitive tissues such as eyes. Evidence suggests that these effects, if not too severe, may clear up after exposure to clean water. Oil can also block noses and mouths and immobilize flippers, thus interfering with swimming ability.

Species that depend on fur for warmth and buoyancy such as otters, northern fur seals, young sea lions and harbour seals, may be the most sensitive to oiling. Experimental evidence suggests that fur bearing marine mammals may experience drastic losses of warmth and buoyancy due to oiling and these effects can last for several days. Oil causes matting and loss of insulation, which may result in hypothermia and death.

Oil can also be ingested directly during grooming or by feeding on oiled prey, or indirectly through the food chain. Ingestion may result in effects on nervous and reproductive systems.

Because otters feed on seabottom organisms, some of their food supplies may be affected by oil settling on bottom sediments.

Based on existing information, the major concern regarding seals, sea lions and otters is the potential for oil reaching a haulout or rookery site. If this should occur, some animals could be killed or suffer sublethal effects.

Inventories of major seal and sea lion rookery and haulout sites are available. These sites are located in nearshore areas, underscoring the vulnerability of the nearshore areas to oil.

Cetaceans

Oil can also affect cetaceans, which include whales, dolphins and porpoises. It can damage sensitive tissues such as eyes, foul blowholes, and have minor, short-lived effects on skin.

There is evidence that whales and dolphins will avoid oil slicks but they may not be able to detect thin surface sheens. Some species of dolphins and baleen whales have been observed swimming and apparently feeding in oil slicks. This could result in the ingestion of oil especially through feeding on contaminated prey. In addition, baleen whales such as the grey whale, which feed on seabottom organisms in nearshore areas, might have their baleen fouled by oil while feeding in contaminated waters.

Grey whales are known to migrate along the coast within a few kilometres of shore. However, there have been no systematic surveys of the seasonal distribution and abundance of whales and dolphins on the west coast.

SOCIO-ECONOMIC EFFECTS OF A BLOWOUT

A major oil blowout could have significant socio-economic effects on the British Columbia north coast and the residents of its communities.

Some communities would be affected more severely than others should a blowout occur. Depending on winds and surface currents, oil would come ashore in relatively higher concentrations in certain areas. More severe effects would occur on the communities which depend on those areas for resource harvesting. Diet, income, social structure and culture could be affected and the continued viability of some communities threatened.

Although the socio-economic effects of a blowout would be felt most strongly at the community level, significant regional effects could also occur. The most serious of these would be damage to the salmon fishery, which provides the majority of the income from commercial fishing. The damage to fish and shellfish stocks could reappear at intervals long after the actual event. For example, damage to a year-class of salmon or herring would be evident at regular intervals for decades. Repopulation of an area where shellfish and invertebrates were harvested for food could take years.

If fish and shellfish stocks were damaged, fishing and harvesting closures would follow. These closures could seriously affect the commercial fishing industry and, in the case of shellfish, could last a year or longer.

Previous sections of this report have described the socio-economic dependency of coastal native peoples on the marine resources of the region. It is also clear that very little information exists to document these resource uses. This could present a considerable problem in the design of contingency plans to deal with the possibility of an offshore blowout, or in the administration of compensation programs dealing with the effects of a blowout.

The Panel recommends that programs be undertaken to improve the quality and quantity of information related to native food fisheries in the region.

Another concern is the possibility of fish tainting and its impact on the commercial fishery. Tainting is the contamination of fish by hydrocarbons, giving them an oily odour and unpalatable taste and making them unmarketable. Because contamination cannot be detected in advance of consumption, tainting of only a very small proportion of a fish catch could threaten the market value of an entire catch. In addition, publicity about a blowout could create consumer perceptions that the whole British Columbia fishery was contaminated and affect overall marketability of the catch.

Effects on the fishing industry could also extend to southern-based fishermen, who harvest an estimated 60% of the commercial chinook in the region, and to the fish processing sector, which is a major employer in the region.

The Panel recommends that, before exploratory drilling begins, the Department of Fisheries and Oceans develop a contingency plan for managing the commercial fishery after a blowout, including monitoring of fish for tainting and administration of closures.

The effects of a blowout upon the developing mariculture industry in the region is another concern. Although commercial mariculture development is still in its early stages, there is potential for considerable growth of this activity in the future. Mariculture could become an important industry on the west coast, and could be especially important for small communities. Mariculture sites are vulnerable to oil.

The exploration area contains numerous sites with recreational, environmental and cultural attractiveness. Outdoor recreation is important to north coast residents, and the basis for a rapidly expanding tourist industry. Individual operators and communities have started to develop the region's tourism potential for wilderness recreation and sport fishing. Much of the appeal of the north coast is based on its pristine condition and natural attractions. Intervenors argued that news reports of an oil blowout would create a perception that the waters of the region were polluted, affecting the region's attractiveness as an outdoor recreation and tourism destination.

PROTECTION OF NEARSHORE WATERS

Nearshore environments and estuaries are particularly vulnerable to oil contamination. The intertidal zones in these areas often support highly productive ecosystems, because of abundant light, shelter and nutrients. Shallow nearshore waters and bays have a rich and varied plant life, including marsh grasses and seaweed, which provide food and shelter to a variety of animals. Estuaries, which are formed at the mouths of streams or rivers, are particularly important.

Nearshore environments, especially estuaries, provide habitat and food for migrating juvenile salmon as they make the transition to salt water. Nearshore areas also provide habitat for many species of shellfish and invertebrates, which are harvested for food and income. The growing mariculture industry is also located in these areas.

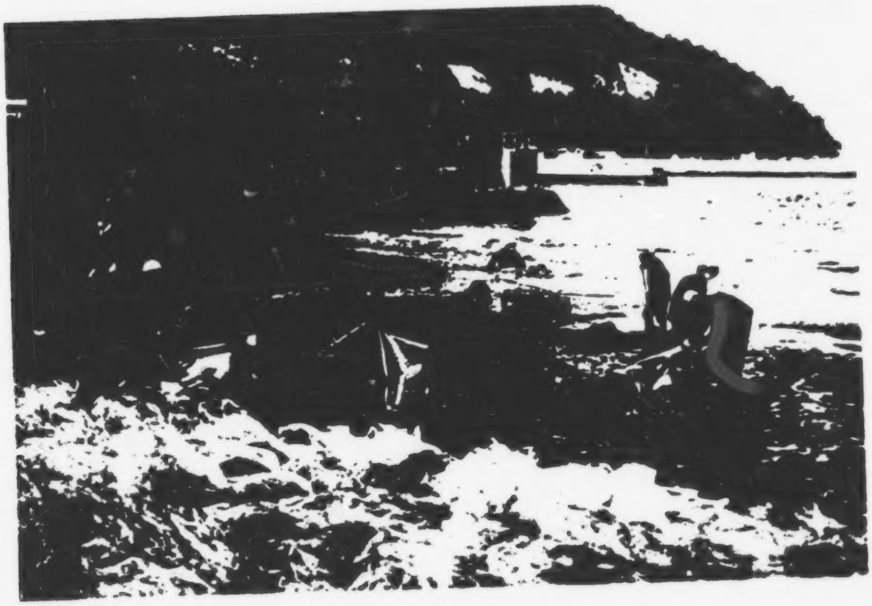
Seabird breeding colonies and stopovers for migrating birds of international significance are located in nearshore areas and large numbers of marine-associated birds feed and swim there. Seal and sea lion haulout sites, rookeries and feeding areas are located in these waters and certain whales migrate and feed close to shore. The scenic, unspoiled coastal areas of the north coast are the major attraction of a growing outdoor recreation and tourist industry.

Several shoreline and nearshore sites within the region have been set aside as ecological reserves where typical or unique species or ecosystems are protected for scientific study or conservation.

Certain offshore areas are also important for primary production of plankton and provide the habitat for numerous species of fish, birds and marine mammals. However, because the oil is not trapped by a shoreline blocking its drift, offshore areas are usually susceptible for shorter periods. Of most concern would be the waters close to a blowout where oil would not be weathered.

The west coast environment has a rich and varied ecosystem highly vulnerable to oil. A major oil blowout could have serious effects on that ecosystem. While offshore waters may be important to various species at certain times, nearshore waters are important all of the time. Exploration lease areas on the west coast are closer to these sensitive and vulnerable shores than those off the east coast of Canada, or those in northern North Sea fields. As a result, drifting oil would be fresher when it reached the shore.

The most important factor in judging the biological effect of oil is the time it will take for the oil to reach sensitive nearshore areas, given the seasonal wind and current patterns. The farther a blowout occurs from shore, the greater will be the weathering of the oil, and the more time will be available for response teams to implement countermeasures. This underscores the need to maintain a buffer zone between drill sites and the shore. **The Panel, therefore, concludes that a 20 kilometre exclusion zone is an essential limitation on exploratory drilling.**



Spill cleanup crew

10. OIL BLOWOUT CONTINGENCY PLANNING AND COUNTERMEASURES

CONTINGENCY PLANNING

An oil spill contingency plan is an action plan for responding to oil released by a blowout. It describes actions that would be taken to avoid or reduce the impacts of an oil blowout.

The Canada Oil and Gas Lands Administration requires a site-specific oil blowout contingency plan before it will approve a drilling program. The plan is prepared by industry operators, in cooperation with government agencies, at the time they apply for specific drilling permits. The contents of a contingency plan are described in Canada Oil and Gas Lands Administration's Guidelines and Procedures for Drilling for Oil and Gas on Canada Lands (September 1984). The British Columbia Ministry of Energy, Mines and Petroleum Resources also requires contingency plans in its draft Drilling and Production Regulations.

This section considers some of the requirements that should be included in contingency planning, such as sensitivity mapping, organization and countermeasure operations.

SENSITIVITY MAPPING FOR CONTINGENCY PLANNING

For effective contingency planning, information on important resources at risk to an oil blowout must be sufficiently detailed to provide a basis for determining how and where various countermeasures should be deployed. Many participants argued that information for identifying important resources vulnerable to oil on the British Columbia north coast is inadequate to meet this requirement. These resources include fisheries, bird or marine mammal concentrations, sensitive nearshore areas and estuaries, recreation and heritage sites and ecological reserves.

In responding to an oil slick's movement, the on-scene commander needs information identifying the most important areas, rather than detailed descriptions of the resources at each site. This information is best provided on sensitivity maps, which highlight priority areas and their sensitivity to oil at various times and seasons. They should also include information on the best measures for protecting those areas and for cleaning up oil should it reach the shore.

The Initial Environmental Evaluations prepared by Chevron and Petro-Canada identified important coastal resource areas. Further information, including further research needs, was provided by government and Chevron in response to the Requirements for Additional Information. This information provides a starting point for mapping priority resource areas for contingency planning. A resource mapping program sponsored under the Environmental Studies Revolving Fund is underway for the Queen Charlotte Islands, and Chevron stated it would conduct further programs to obtain the information needed to meet requirements for obtaining a drilling permit.

Information is also needed on the domestic use of marine resources, particularly the native food fishery. Because local residents have concerns about the confidentiality of this information, it is important to involve them in identifying priority areas for protection. This ensures that local knowledge and interests are recognized in the mapping process.

Finally, inventories are needed of the large number of archaeological sites along the shorelines and intertidal areas of the north coast. Many of these sites could be exposed to oil stranded on the beach and could be further disturbed by inappropriate cleanup activities.

To ensure that it contains the latest and most complete information, the Panel believes that sensitivity mapping must be updated regularly by resource agencies and industry. Clear responsibility must be assigned for updating. Agencies involved in updating should also be involved in the original data collection so that they understand the methods and limitations of the data base.

The Panel recommends that, before exploratory drilling is approved, the regulatory authority ensure that:

1. **coastal sensitivity mapping begun under the Environmental Studies Revolving Fund is expanded to cover areas that are now inadequately mapped;**
2. **the native food fishery and resource harvesting activity are included within this mapping, with native people involved in acquiring and developing this information;**
3. **arrangements are in place to ensure that sensitivity mapping is maintained and updated jointly by the British Columbia Ministry of Environment, Environment Canada, the Department of Fisheries and Oceans and industry; and**

4. **the Heritage Conservation Branch of the Government of British Columbia completes an inventory of archaeological and cultural sites vulnerable to oil and ensures that measures to protect these sites from inappropriate cleanup procedures are included in contingency plans.**

ORGANIZATION

Effective implementation of a contingency plan requires a well trained response team. This is particularly true if the team includes several government agencies, local communities, contractors and operators, as would be the case on the west coast.

Under present arrangements, the polluter has initial responsibility for cleanup of an oil spill. If the polluter is unable to clean up a spill, government agencies may step in to complete the cleanup and bill the polluter for the costs.

Several agencies are responsibile for responding to oil spills on the west coast. The Canadian Coast Guard has primary responsibility for spills from ships. Environment Canada is the lead agency for spills from land into marine waters and mystery spills. The Provincial Emergency Program of the British Columbia Ministry of Environment deals with spills on land and spills into fresh waters. The Canada Oil and Gas Lands Administration is the lead agency for spills from offshore drilling operations, including oil blowouts.

The present system for responding to spills on the west coast, involving the Canadian Coast Guard, Environment Canada and the Provincial Emergency Program, has evolved over several years. It is utilized frequently in the many minor accidents that occur in British Columbia waters every year. **The Panel believes that this system should be the basis for a government oil blowout response on the west coast. Given its responsibility for the more common offshore spills, the Canadian Coast Guard should also be the lead agency for responding to oil spills resulting from blowouts. The Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources should be the lead agencies for rig-related actions necessary to control a blowout.**

The Panel recommends that, in the event of a blowout,

1. **the Canadian Coast Guard coordinate government involvement in responses to an oil spill resulting from a blowout; and**
2. **the Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources coordinate government responsibilities for rig-related actions to control blowouts.**

Typically, residents volunteer to help clean up shorelines in an area where slicks come ashore. The participation of local residents would be valuable given their knowledge of local environmental conditions and especially of subsistence food resources. **The Panel believes that local residents, who have a large economic and social stake in the protection of marine resources, should be included in cleanup planning. To enable these residents to participate safely and effectively in a blowout response, they should be trained for their roles.**

The Panel recommends that the regulatory authority ensure the establishment of programs to train, organize and equip local residents for participation in oil spill countermeasures and cleanup.

> *"I wonder if it isn't more reasonable to make the people in the area where the oil might spill, aware of what has to be done and in a minimal way coordinate a type of emergency response capability that would be there if anything did go wrong." (Kevin O'Neill, Central Coast Fishermen's Protective Association, Bella Coola, September 1985)*

PREPARATION AND UPDATING

Although practice exercises can identify weaknesses in a contingency plan, a plan is only properly tested in an emergency situation. A "paper plan" may be rendered useless by unforeseen problems such as adverse weather, logistical constraints, or human error. To prepare for these unforeseen factors, contingency plans must be thorough, detailed, flexible, and realistic. Adequate resources must also be available at all times to carry out these plans.

Because good logistical support is vital to the effectiveness of contingency plans, these plans should provide details on how this support is to be mobilized and maintained. Equipment for countermeasures, cleanup and logistical support should be catalogued, along with its location and how quickly it can be mobilized. Detailed arrangements should be made for field headquarter facilities, accommodation and catering, communication systems, and air and water transportation. Advance arrangements are particularly important on the west coast due to the remoteness of the region, limited transportation facilities, and the high incidence of fog and poor visibility.

Once a contingency plan is prepared and tested, it must be kept current. A plan which contains outdated information is no longer functional. The location and availability of countermeasure equipment, air and sea transportation services, accommodation facilities, communication systems and key personnel must be checked and updated frequently.

> **The Panel recommends that, before exploratory drilling is approved, the regulatory authority ensure that arrangements are in place to regularly test and evaluate operator and government contingency plans.**

TRAINING AND EXERCISES

Company and government personnel must receive adequate training for their assigned roles in a blowout response. Training programs should take place jointly between industry and government so participants meet face to face with their counterparts in a setting conducive to cooperative effort. Local residents with major roles in a response must be included. Training programs are available, such as those sponsored by Transport Canada at Cornwall, Ontario, that review Canadian spill situations and responses.

Frequent oil spill training exercises in which response operations are practised are important for ensuring equipment deployment plans function properly, equipment is serviceable and logistical support is adequate. They are also important for ensuring that the response team is well organized and ready. Exercises should involve all phases of an oil spill response including the spill reporting and notifications systems, logistics and cleanup equipment mobilization.

Exercises should be held in realistic conditions, and should not necessarily be scheduled on a weekday or during good weather in summer. They should test the ability of the operator and government to initiate countermeasures on short notice.

To be effective for testing and training, exercises should be conducted with all participants, including government personnel, actively involved rather than observing. After the exercise, participants should be debriefed and contingency plans rewritten where necessary.

> **The Panel recommends that the regulatory authority ensure that at least one full scale oil blowout response practice exercise is carried out during the initial exploration period, and if an extended exploration program takes place, that at least one exercise is carried out each year.**

COUNTERMEASURE OPERATIONS

Countermeasures are procedures and technologies available to respond to spills. These include measures for tracking slick movements, containing and recovering slicks, dispersing slicks, and cleaning up shorelines. These measures vary in effectiveness.

TRACKING AND MODELLING OF OIL SLICK MOVEMENTS

Information on the actual location of slicks and their probable movement is needed so that countermeasures can be deployed where they will protect the highest priority resources. This information can come from tracking and modelling.

Tracking

Various methods have been devised for tracking the movement of slicks. Aircraft are normally used once or twice a day to observe their location. This is effective only during daylight and periods of good visibility.

Radio-transmitting buoys or drifters, which drift with the slick and report their location, are also used. These buoys are helpful in most weather conditions, but are effective only over certain ranges.

Remote sensing technology can also be used. Equipment available in Canada for operation from aircraft includes highly sophisticated equipment such as side-looking airborne radar, infrared/ultraviolet scanners and low-light level television. Adverse weather conditions and darkness could interfere with the remote sensing capabilities of some of this equipment.

The Panel concludes that existing technology and ongoing research should provide an ever-improving capability to track the location of slicks. However, it is important that the types and quantities of equipment needed be readily available at the time drilling begins.

> **The Panel recommends that, before exploratory drilling is approved, the regulatory authority require operators to provide detailed descriptions of:**
>
> 1. **the monitoring and surveillance procedures and equipment that would be used to monitor the location of slicks from a blowout;**
> 2. **the location and availability of equipment and how it would be deployed; and**

3. **the adequacy of these procedures and equipment for use in tracking slicks from a blowout at the specific drilling site.**

Trajectory Models

Oil spill trajectory models are computerized simulations of the behaviour of oil from a blowout or a spill site. They attempt to predict the movement, spread and condition of the oil at various times as it moves over the sea. In order to do this with confidence, knowledge of the type of oil and amount being ejected at the spill site, along with data on winds, currents, sea state and sea and air temperatures along the spill trajectory is needed. Such models are used for two purposes, contingency planning and tracking oil slicks on the sea from a blowout or a spill.

The Canada Oil and Gas Lands Administration requires contingency plans to contain a prediction of where oil might go from a hypothetical blowout at a drilling site. Predicted tracks and destinations, computed at intervals throughout a year, are used to assess risks to vulnerable marine resources both in and on the sea and at coastlines. For these predictions, historical climate records of winds are customarily used, and at times are supplemented by available surface current data.

Technical experts and the Department of Fisheries and Oceans believed that this use of trajectory modelling was useful for contingency planning but stressed that surface currents must be considered along with winds in computing trajectories. The Department of Fisheries and Oceans suggested at least one year's data on surface currents in the vicinity of a proposed drilling location is needed. **While the Panel does not accept the overall utility of trajectory models as a key element of tracking oil spills, it does accept their usefulness in contingency planning. The Panel believes present information on surface currents in the region to be inadequate.**

> **The Panel recommends that at least one year before exploratory drilling begins, the Department of Fisheries and Oceans, in cooperation with industry, implement a surface current measuring program in the region of the drilling site, and that industry include surface current effects for the purpose of developing contingency plans.**

A trajectory model is theoretically a very useful tool in oil spill countermeasure operations. Models would allow some predictions of the likely track of oil during darkness and inclement weather. However, any model is limited by the quality and availability of input data.

Technical experts as well as intervenors with modelling experience were skeptical about the usefulness of models during countermeasures operations, not only because of the difficulty of measuring winds at sea and surface currents, but because of the apparent inability of available models to simulate complex and variable physical processes.

Descriptions of the complexities of surface currents in this region emphasized the fundamental difficulty of defining oil slick patterns on the sea as time progresses.

The Panel believes that oil spill trajectory models are not a promising tool for tracking the movement of oil slicks from a blowout on the north coast. Instead, primary reliance should be placed on radio-located tracking buoys deposited at the blowout site and wherever slicks are subsequently found.

> **The Panel recommends that during oil spill countermeasure operations, emphasis be placed on the use of radio-located tracking buoys as sensors to provide position updates for oil slick tracking.**

EFFECTIVENESS OF COUNTERMEASURES

The ability to minimize damage from an oil blowout depends on the effectiveness of the countermeasures used for containing and dispersing slicks, and for the cleanup of shorelines. The Panel received information indicating that existing countermeasures would have limited effectiveness on the west coast.

Containing and Recovering Oil Slicks

The containment, concentration and removal of oil slicks by mechanical means such as booms and skimmers is obviously the preferred method of handling an oil slick because the oil is removed from the sea. Chevron, Environment Canada and the Canadian Coast Guard, however, indicated that the ability to do this with present containment and recovery technologies is limited.

> *"We wouldn't work in a sea state in excess of four feet because first we have to consider the safety of our workers. I'm talking about attempting to do physical recovery. We wouldn't be able to hold our booms in position . . . We don't work in the dark. The safety of our workers comes first . . . So offshore recovery would be limited to working under very good weather conditions." (Ian Young, Canadian Coast Guard, Vancouver, November 1985)*

Containment boom

Booms and skimmers function only in relatively calm seas and become less effective as wave heights and current speeds increase. In addition, the drifting and spreading of oil as it moves from a blowout site make slicks more difficult to recover over time. Operational problems also result from fog and darkness, and there are logistical problems in getting equipment in place and in disposing of recovered oil. Equipment is subject to maintenance and other problems, and the effectiveness of equipment diminishes as the oil is weathered and becomes more viscous or emulsified. In their blowout scenarios, government agencies projected recovery efficiencies at less than 10 percent for oil recovery operations near a blowout.

Although containment and recovery measures alone are of limited effectiveness, they are useful when combined with other countermeasures, and in specific situations. As a result, they are an important element in the overall contingency plan. The contingency plan should include projected equipment and manpower needs for containment and recovery measures for the offshore, nearshore, intertidal and shore zones as well as a general strategy for deploying these countermeasures.

The Canadian Coast Guard has the lead role in responding to shipping spills. Given the environmental sensitivity of the west coast and the tanker traffic off the coast, the Panel was surprised to learn that the offshore oil spill countermeasure capability of the Canadian Coast Guard is almost non-existent. The Canadian Coast Guard stated it does not currently possess an effective offshore spill response capability and would encounter significant difficulties in dealing with oil coming ashore over a broad front. **The Panel concludes that resources of the Canadian Coast Guard for implementing countermeasures must be upgraded.**

> **The Panel recommends, that before exploratory drilling is approved, the Canadian Coast Guard upgrade its resources for responding effectively to offshore oil spills, including trained personnel, modern equipment, depots, communications systems, and the logistical capability to deploy these resources quickly.**

Using Dispersants to Disperse Oil Slicks

Dispersants are chemicals that physically convert oil slicks to small droplets, which disperse into the water column. Oil is thereby removed from the surface and the influence of winds. This may be advantageous if onshore winds are blowing. Dispersants work best in more turbulent seas and are, therefore, an alternative when the sea is too rough for containment and recovery operations.The principal concerns associated with dispersants are their toxicity and effectiveness.

It is generally agreed that the toxicity of many of the recently developed dispersants is low for most marine life. However, dispersants would considerably increase the concentrations of oil in the water column, and there is concern that this dispersed oil could reach toxic concentrations for certain important marine species such as salmon and herring.

A second question is whether dispersants reduce the damage potential of a slick. Chevron stated that dispersants are effective in removing the oil from the surface without producing toxic concentrations of oil in the water column. Environment Canada, however, stated that the tested effectiveness of dispersants varied from 0 to 100 percent, depending on oil types and prevailing sea conditions. Effectiveness also depends on the specific agents to be applied, the application techniques used, the sea conditions at the time of application, and the logistics of the operation. All these factors must be considered carefully in contingency plans. In addition, because of concerns that dispersants may cause toxic concentrations of oil in the water column, agencies such as the Department of Fisheries and Oceans, Environment Canada and the British Columbia Ministry of Environment may be reluctant to permit their use. For these reasons, the role of dispersants in contingency plans is in question.

> *"Can oil spills be cleaned up? Again, it comes to a question of performance, and we have some real information here. Only about 10 to 20 percent of the oil is actually recovered from a spill situation. I can provide you with some references on that, if necessary, and as much as 60 percent of the light oil, however, may evaporate from that particular spill." (Jim Steele, Council of the Haida Nation, Victoria, October 1985)*

The Panel recommends, before exploratory drilling begins, that:

1. **Environment Canada and the British Columbia Ministry of Environment clarify the circumstances under which their respective governments would permit or prohibit the use of dispersants, and in cooperation with industry, develop a strategy for the use of dispersants if these are not prohibited; and**
2. **operators incorporate this dispersant strategy into their contingency plans.**

Cleaning Up Shorelines

Should a blowout occur, oil might come ashore. Changing winds and currents which could re-oil shorelines may also be anticipated. Due to the social and environmental sensitivities of British Columbia's coastal resources, it is important that the operator demonstrate an adequate capability to mitigate the effects of oil on shorelines.

Shoreline cleanup usually involves manual methods that can continue for months following the initial accident. In addition, both oil and debris would have to be contained, mechanically removed, transferred, stored and disposed of. Attempts to intercept slicks may be ineffective as they move shoreward over relatively broad fronts. **The Panel believes that to facilitate effective, well planned shoreline cleanup operations, strategies should be detailed in contingency plans.**

The Panel recommends that, before exploratory drilling is approved, operators include specific strategies in their contingency plans, for cleaning up shorelines that are vulnerable to oil from a blowout at a proposed drilling site, including details on the types and availability of equipment that would be used, manpower requirements, training provisions, operational logistics and guidelines for cleaning up individual shoreline areas.

APPLYING EXPERIMENTAL COUNTERMEASURES

Considerable research has been underway worldwide, especially over the past decade, to develop new approaches for controlling and removing oil slicks. For example, there are new methods of applying chemical dispersants, new mechanical containment and recovery systems, in-situ combustion of oil using laser beams, air-deployable igniters, fire-resistant booms, gelling agents (coagulants), subsea containment devices, portable incinerators and burners and beach cleaners.

While some of these technologies are almost ready for commercial use, others are at a research or prototype stage. Advances are being made and important new countermeasure technologies may become available during the exploration period. The development of these new technologies should be closely monitored and included in contingency plans as appropriate.

The Panel believes coagulants are an especially promising new technology. Coagulants are chemicals that are applied to oil slicks to cause the oil to solidify. Coagulants could be especially useful for protecting certain high priority coastal sites. Coagulated oil would be easier to clean up in sensitive areas because it would be less likely to penetrate sediments or harm biota. Some problems still need to be resolved, such as the high cost of coagulants and the logistics of their application. **However, the Panel concludes that the development of coagulants should be closely monitored for possible inclusion in contingency plans.**

> *"Sometimes it's physically impossible to clean your shoreline, and I would suggest that the coastline of the Charlottes would tend to be that way unless you have beaches, and that's a very slow process." (Ian Young, Canadian Coast Guard, Vancouver, November 1985)*

11. COMPENSATION

Avoiding or mitigating impacts is a major objective in managing the environmental aspects of project developments. When impacts can be neither avoided nor mitigated, compensation for damages and losses incurred must be provided. In the proposed west coast offshore hydrocarbon exploration program, compensation could be necessary as a result of an oil well blowout or from routine operations.

This section considers what losses should be compensable and under what conditions, as well as the mechanisms for settling compensation claims.

COMPENSABLE LOSSES AND DAMAGE

Losses and damage resulting from an oil well blowout or routine operations fall into three general categories:

1. Loss of or Damage to Property and Equipment

These types of losses and damages are generally amenable to direct financial compensation and include:

—loss of or damage to fishing gear; and

—damage to fishing boats or other vessels.

2. Loss of Income

Compensation here would be designed to replace lost income. Examples include:

—loss of anticipated fish catch;

—loss of access to fishing areas or closure of fishing areas;

—loss of sales as a result of tainting of fish by oil affecting the marketability of catches; and

—losses to the tourist trade following an event which affects perceptions about the attractiveness of an area.

3. Loss of or Damage to Resources

Compensation for these losses and damages would normally consist of resource rehabilitation. Examples include:

—damage to, or loss of, fish stocks;

—damage to, or loss of, marine birds;

—damage to, or loss of, other marine resources;

—aesthetic losses;

—loss of future resource enhancement opportunities; and

—damage to, or loss of, resources with cultural importance.

Losses can also be classified as attributable or nonattributable. Attributable losses are those that can be directly attributed to a specific operation or operator. Nonattributable losses are those that cannot be attributed to a specific operation or operator.

PUBLIC CONCERNS AND ISSUES

Issues raised during the hearings included what items would be covered by a compensation program and how such a program would be established and administered.

Compensation to cover losses suffered by fishing interests was the primary concern. Commercial fishermen were concerned about direct losses, such as damage to fishing gear from either routine operations or a well blowout, as well as loss of income due to fish tainting and fishing closures if a blowout were to occur. Fish processors were concerned about indirect economic losses. Others expressed concern about costs associated with the possible foreclosure of future fishery enhancement options, or increased costs to government for relocating displaced resource users and reestablishing lost resources.

Native people were most concerned about how they would be compensated should an oil well blowout damage or destroy the marine resources that supply much of their food and play an important role in their culture.

Concerns were also expressed regarding losses that could be experienced by recreational and tourism interests in the event of an oil well blowout, and how they could be compensated for such losses.

Participants expressed concern that when compensation claims are being reviewed, claimants would be at a disadvantage. They pointed out that the oil industry could afford the best legal advice to help plead their cases and technical staff to research and support their positions. The claimants, on the other hand, would have to prove the legitimacy of their claims without the level of resources available to industry.

Other compensation-related issues raised during the hearings were how to quantify losses, how to assign a value to a noneconomic loss, who should be compensated for the loss of common property resources, how to compensate for damages to ecological reserve areas, and how to compensate for resource losses that take many years to recover.

Participants were also concerned about how a compensation program would be established and administered. Many expressed the need to have a comprehensive compensation program in place before the start of exploration drilling.

Chevron stated that it operates under the principle that persons who suffer economic losses or damages directly attributable to its operations will be fully compensated to the point where they are no worse off than they would have been had the exploration activity not taken place. At one point, Chevron stated that the full assets of the company would be available to compensate for losses, in the unlikely event of a catastrophic oil blowout which resulted in damages in excess of its normal liability limits. **The Panel endorses this commitment but believes that compensation limits, programs and mechanism must be more fully and formally defined prior to the commencement of drilling.**

PRESENT MECHANISMS FOR COMPENSATION

Under the Oil and Gas Production and Conservation Act as amended by the Canada Oil and Gas Act, a well operator is liable for all actual losses or damages incurred by any person as a result of an oil well blowout or resulting from debris created by a drilling operation.

Chevron expects most, if not all, damage claims can be settled directly between itself and the person or group suffering damage. If agreement cannot be reached between the operator and the damaged party, then recourse to further action is available under the federal Oil and Gas Production and Conservation Act. Failing this, and as a last resort, any disagreements can be referred to the courts for action.

No provincial legislation or regulations are in place to cover compensation for losses relating to an offshore exploration program. A British Columbia Environment and Land Use Committee document entitled "Environmental and Social Impact Compensation and Mitigation Guidelines" reflects provincial policy on this matter. The document sets out suggested principles to guide resource agencies in negotiating with developers on both mitigation and compensation measures.

Under the Fisheries Act, a licensed commercial fisherman may claim through the courts for loss of income from oil well blowout damage. However, the Act does not cover situations where damage cannot be attributed to a specific operator.

During the hearings, the Canada Oil and Gas Lands Administration stated that specific Exploration Permit agreements between itself and an exploration well operator could include details of a specific compensation package.

OFFSHORE COMPENSATION PROGRAMS IN OTHER JURISDICTIONS

The Panel examined compensation programs that are already in place in other parts of Canada and in the North Sea where offshore exploration or production is taking place alongside an established fishing industry. Although the programs varied considerably, they generally addressed two areas of compensation:

1. compensation for oil well blowout damages; and
2. compensation for sea floor debris related damages.

Some programs are government run, some are established and managed by the oil industry itself and some are joint government-industry programs.

The East Coast Fishermen's Compensation Policy, established by the oil companies engaged in activities off Canada's east coast, was examined in greatest detail. This program enables fishermen to claim compensation for nonattributable damage resulting from offshore exploration and production activities. Claims can be made for gear and equipment loss or damage, vessel damage, loss of catch and, in certain cases, loss of vessel. The claims

> *"... is there a way that you could put together something that could replace a race of people, should they be destroyed, because their whole dependency is on the ocean — not only on the fish, the salmon, but all the other resources related to the ocean and the surrounding area." (Matthew Hill, Chief Councillor, Kitkatla, September 1985)*

are dealt with by three separate compensation boards covering three east coast areas. The compensation boards are comprised of representatives from fishing and oil industry associations on the east coast.

The East Coast Fishermen's Compensation Policy is limited in its coverage. It does not apply to losses that can be directly attributed to a specific operator, or that result from oil well blowouts; and it does not apply to losses that cannot be quantified in economic terms. In spite of these limitations, the industry-to-industry nature of the program and, more specifically, the person-to-person nature of most of the negotiations has led to greater understanding between the two industries and a greater respect for each other's problems.

On the east coast of Canada, the Canada Oil and Gas Lands Administration has required operators to submit proof of financial responsibility in the form of $30 million financial security. This money is available to settle damage claims. In addition, it would be used to cover the cost of cleanup after a blowout. For offshore operations in Canada's Beaufort Sea area, $40 million of financial security has been required.

Government has yet to set a limit of financial security for west coast offshore operations. It should be noted that no matter what limit of financial security is set, this amount will not place a limit on the absolute liability of an operator. If attributable damage in excess of the financial security limit occurs, the operator is still liable for all compensation required.

COMPENSATION POLICY AND PROGRAMS

The Panel believes the government regulatory authority should develop an overall compensation policy covering all stages of exploration before exploration activity begins. This policy should clearly set out the principles to be followed in establishing specific compensation programs, so that potential operators will know what will be required of them in proceeding with their exploration programs.

> **The Panel recommends that a government compensation policy covering all stages in an exploration program be established before exploration activity begins, and that this policy be based upon the following basic principles:**
>
> 1. **Compensation is to be provided for situations involving loss of, or damage to, property and equipment.**
> 2. **Compensation is to be provided for situations involving loss of income.**
> 3. **Compensation is to be provided for situations involving loss of, or damage to, common property resources.**
> 4. **Attributable and nonattributable damages and losses are to be covered.**
> 5. **The burden of proof in any dispute over compensation for damages or income loss is to rest with the oil companies rather than the claimant; the onus is to be on the companies to support their disclaimer "on the balance of probability."**
> 6. **As both the oil industry and government will share in benefits to be gained from the exploration program, both should share in the financial responsibility for any common property resource losses or damages incurred.**
> 7. **Compensation programs relating to common property resource losses should emphasize replacement of the resource rather than financial compensation.**

Situations requiring compensation as a result of routine offshore exploration operations will usually be less serious than those resulting from an oil well blowout. If Chevron adheres to its undertakings to follow through quickly and fairly with all reasonable claims, and if other operators do the same, then compensation claims related to routine operations should be easy to deal with. **The Panel believes**

that a formal compensation program and mechanism for compensable situations resulting from routine operations must be in place prior to the commencement of exploration.

> **The Panel recommends that any disputes arising out of compensation claims relating to routine operations that cannot be resolved between the two parties be referred to third party arbitration.**

Situations requiring compensation as a result of oil well blowouts are potentially much more difficult to handle and require special treatment. **The Panel believes that the policy for this type of compensation should be established prior to the commencement of drilling.**

> **The Panel recommends that a policy for compensating losses and damages resulting from significant oil well blowouts, following the basic principles set out by the Panel and containing the elements outlined by the Panel, be in place before any exploration drilling begins.**

The policy should include the elements outlined below:

1. Proof of Financial Responsibility

The Panel believes that each operator should be required to prove its financial ability to cover potential loss or damage resulting from a significant oil well blowout, along with cleanup and restoration costs.

> **The Panel recommends that before any drilling begins, each operator be required to post a $40 million bond or irrevocable letter of credit.**

This proof of financial responsibility should not consitute an absolute level of liability, but would be available to cover the following :

a) cleanup costs from an oil blowout including the cost of removing oil from the sea and the shoreline, and restoring the affected areas to prespill conditions if deemed necessary by the regulatory authority in consultation with appropriate government agencies;

b) attributable loss of, or damage to, property and equipment;

c) attributable loss of income; and

d) attributable damage to, and loss of, common property resources, where compensation would normally consist of resource rehabilitation rather than financial compensation.

Given the government's role in authorizing offshore exploration and the financial benefit it will enjoy if commercial resources are found and given its role as steward of the common property resource, the Panel believes that the government should accept a share of the financial responsibility for common property resource rehabilitation.

> **The Panel recommends that government accept a financial liability of $10 million towards any resource rehabilitation programs that are found necessary to replace resources lost from an oil well blowout.**

> **The Panel recommends that the absolute financial liabilities to be borne by the operator and government for resource rehabilitation programs not exceed $20 million to be borne equally by government and the operator.**

> **The Panel recommends that in the event of a blowout, the need for resource rehabilitation programs be determined by government, and that these programs be designed and implemented by the appropriate government agencies.**

2. Compensation Board

In the event of a significant oil well blowout, the Panel believes that a special body should be available to help adjudicate compensation claims.

> **The Panel recommends that a West Coast Offshore Compensation Board be appointed if and when a significant oil well blowout occurs.**

> **The Panel recommends that the West Coast Offshore Compensation Board consist of at least three members, include equal representation from the oil industry and the fishing industry, and be headed by an independent Chairman.**

The duties of the Compensation Board should include the following:

a) Receive and adjudicate claims for loss and damage for situations in which the claimant and the oil company cannot agree upon responsibility or the amount or nature of compensation.

b) Provide recommendations on appropriate resource rehabilitation programs to deal with losses and damages to common property resources that cannot be quantified in economic terms.

12. DEVELOPMENT AND PRODUCTION CONSIDERATIONS

The Panel's mandate stipulates that a detailed assessment of the development and production phase will not form part of the Panel's review, but that major issues should be identified for further public review in case exploration should lead to a commercial discovery. The Panel has, therefore, identified several matters that will demand attention should a development and production phase be contemplated.

DEVELOPMENT AND PRODUCTION SYSTEMS

The events leading to development of a hydrocarbon reservoir and production of oil and gas are described below.

Once a well test establishes a potentially commercial discovery of oil or gas, or both, the discovery well is plugged with cement, cut off below the seabed and capped. All debris is removed from around the wellhead and the well is abandoned. The discovered accumulation would then be more precisely defined by a detailed seismic survey and delineation drilling. A minimum of four delineation wells would normally be drilled to define the size and quality of the discovery. These wells, once drilled and tested, are also abandoned.

At this point, in almost all cases a decision can be made regarding whether the gas or oil reservoir is large enough and of sufficient production capability to warrant commercial development. The decision would be based on the depth, areal extent and thickness of the reservoir, the reservoir's physical parameters, the recovery mechanism, the potential for enhanced recovery, the type and properties of the oil, the market conditions and projections, and the fiscal regime. An affirmative decision would result in large investments in development drilling, production facilities and a means of transporting the product to market.

Once large oil or gas accumulations have been outlined, one, two or more sites, appropriately located over the reservoir area,would be selected to receive production platforms. The number of platforms depends on the areal extent of the reservoir.

> *"... In the event that a large quantity of oil is discovered ... will Government ... almost automatic go ahead on the development and production stages? ..." (Kelly Kline, Terrace resident, Kitimat, November 1984)*

Production platforms are permanent, rigid structures made of reinforced concrete or steel, supported on the seabottom and protruding well above the sea surface. Mounted on them are all the necessary module facilities for development well drilling, receiving raw production from wells, separating products, using natural gas for fuelling pipeline flow facilities or for compressing gas on the platform for reinjection into the formation, storing liquids, and loading oil to tankers or transporting oil by a main pipeline to shore or to a tanker loading bay. The platform contains accommodation units to take care of a large number of workers, all control and monitoring equipment, safety and rescue equipment, and a sophisticated internal and external communication network.

All development drilling takes place from the platform. One or more conventional rotary drilling units are mounted on the platform, and wells are drilled fanning out directionally so that they bottom in the pay zone at well spaced and consistent intervals. This ensures that the reservoir is evenly and efficiently drained. The directional traces of all wells are carefully and exactly surveyed from their origins at the platform to the bottoms of the holes. Directional drilling is a highly developed technique, and since the exact position of the hole at any depth must be accurately known, has seen much improvement since offshore drilling started.

Wells are completed in long rows. The drill rig is left on the platform as a permanent facility, so it can be used throughout the life of the field to enter any well for repair purposes. The rig is generally skidded from well to well on guiderails.

Drilling development wells off a fixed platform closely resembles normal onshore drilling. Permanent riser conduits run from the seabed, often through the platform legs, to the platform. All blowout preventors and production control valves are at the platform level. Because these

> *"The actual exploration wouldn't likely have too much direct effect on our area ... But we are concerned with the time after exploration, what then? Our coast line could not afford to have an oil spill ... I realize that you are concerned with the effects of the offshore petroleum exploration. We are as well, but we must look beyond this exploration, to a possible discovery ..." (Lynn Hill, Hartley Bay Band Council, Hartley Bay, Sept. 1985)*

are on the platform rather than the seabottom, more accessible control exists in these long-life facilities than in the mobile semi-submersibles used for exploration drilling.

The crude oil with gas in solution produced by these wells is led to separation vessels where the oil and gas, and, if present,water are separated by gravity. The oil is led to storage or a pipeline. The gas can be used for power generation, reinjected into the oil reservoir, or pipelined to shore for domestic, commercial and industrial use. Separated water is often dumped to the sea.

TRANSPORTATION OF HYDROCARBONS

For a variety of reasons, particularly environmental, oil is commonly pumped by subsea pipeline to a shorebase and storage, rather than being loaded directly into tankers at sea near the platforms. Thus, each platform would likely be equipped with a pipeline connection and pumps to move the oil. The pipeline from platform to shore would be laid on the seabottom by a specialized pipelaying barge. It would often be trenched into the seabed for its own protection and to ensure it is not an obstacle to the fishing fleet. On reaching shore, the oil is led by surface lines to large tank storage to await further overland shipment, export tanker loading or immediate refining.

SHOREBASE FACILITIES

Control of the entire system, including administration, supply, shipping, communications, drilling, well repair, separation, pumping to pipeline, storage receipt and the response to emergencies have been found to be best handled from one location and under one managing entity. The terrain required for pipeline landfall, storage tanks and tanker loading facilities or a refinery, is also generally suitable for good road building, airstrips, helicopter pads, office buildings and maintenance yards. Thus a company usually locates a full-scale operational shipping and administrative headquarters at or near the main onshore pipeline terminal, where the oil comes ashore, and which is generally some distance away from established communities. This arrangement generally maximizes efficiency and minimizes the disruption to existing communities.

SOCIO-ECONOMIC ISSUES

Development and production would bring an abrupt and significant change in the level of industrial activity within the region. New activity would include installing platforms, drilling development wells, constructing shorebases, installing transportation and storage systems, and possibly constructing tanker terminals. Seismic surveys and exploratory drilling would be continuing activities.

This increased industrial activity would result in increased employment and local business opportunities. During the development and construction phase, a large workforce of short-term labour is required. To avoid imposing strains on existing communities, this workforce is usually imported and housed in temporary camps. In some cases, families accompany workers to the camps. Otherwise, generous leaves are granted between work periods. These camps are disbanded when the construction and development work is complete.

The permanent shorebase staff required for the production phase would be considerably smaller than the construction phase staff. It would generally be housed and supplied on a permanent basis at an accommodation facility at the shorebase, and would probably not be imposed on existing communities. Offshore crews would be rotated from their homes and bases.

To prepare local workers for job opportunities, lead time would be required for training programs. The existence of a centralized organization at a shorebase greatly facilitates training. Training schools, supported by the overall infrastructure, could be located at the terminal site and all forms and degrees of operational training could be provided both in school and on the job. Such training would likely be confined to production operations including well repair work. The training of drilling personnel would be a matter for drilling contractors unless the company elected to provide its own development drilling capability. Training would be a continuing activity, with frequent updating required on all matters of drilling well control, emergency occurrences, and oil spill response. Local availability of promising people should be determined, and a prudent operator would make maximum use of all local skills and potential.

As workers enter the workforce, some would experience new lifestyles as they adapt to the typical offshore work schedules involving working 12-hour days for a few weeks at a time, with compensating time off at home. In many cases, offshore jobs would mean high incomes.

Because of the increased scale of industrial activity, development and production could lead to social changes. Some of these changes could occur as local residents react to production and development possibilities. For example, some residents might begin to train privately for jobs or to invest in new businesses. These responses depend on what information residents receive. It is important, therefore, that residents receive full, accurate and up-to-date information about opportunities and limitations associated with offshore petroleum activities. If the information programs recommended by the Panel for the exploration period are operating effectively, residents should have the information required.

Another reaction to increased industrial activity could be a sense of loss of present lifestyles. Some lifestyles may indeed change, particularly traditional or small community lifestyles. Social changes of this type are difficult to measure or monitor, and they can produce a mixture of positive and negative effects. For example, increased employment can bring income, financial stability and prestige. It can also result in long periods away from home and reduced participation in traditional lifestyles. No one from outside the community can judge whether these changes would be beneficial or not. It is important, therefore, that residents themselves have the ability to identify these changes so that they can develop local solutions to any problems which might arise. This requires some form of ongoing local organization in affected communities to review the effects of development on the community and to develop appropriate responses.

The Panel believes that the ground work for managing development and production and for minimizing socio-economic problems must be laid during the exploration phase.

ENVIRONMENTAL ISSUES

Contrary to public perception, the risk of an oil spill is less during development drilling and production operations than in exploration drilling, because of the control equipment on the drilling platform and permanent foundation structures.

For the same reason, oil spills that might occur from development or repair work in production operations can generally be confined to small volumes as a result of these more accessible control features. However, to ensure this, the highest standards of training, experience and practice will have to be maintained at all times.

The Panel believes that routine waste discharges during development and production operations could have more severe environmental effects than those from exploration drilling. Drilling fluid and cuttings discharges will be concentrated at or near the fixed platform in large volume and with possibly much higher toxic effects on fish and wider smothering effects on benthic organisms. Sewage and wash down fluid volumes will also increase, and in the production phase, large volumes of toxic produced-water may need to be safely disposed of.

The method of developing, producing and transporting oil, the location of shore terminals, the size and location of a shorebase and its connection to the terminal, and the provision of a practical means of eventual abandonment of the fixed structures will all likely be matters of considerable contention in the public review of, and planning for, the development and production phases. The Panel foresees potentially serious issues to be resolved on such matters as:

—the effect on bird migrations of platform lights and gas flares;

—the advisability of clustering many development wells on one platform, in view of the fire hazard to neighbouring wells;

—the use of oil-based muds: advantages, disadvantages and disposal problems;

—heavy metal content of mud additives;

—the methods by which accidental routine spills can be mitigated or prevented;

—the impact of routine discharges and oil spills on fish and sea mammals;

—energy conservation, enhanced recovery, the reinjection of products and general reservoir management;

—differences between fixed, floating and tension leg production platforms;

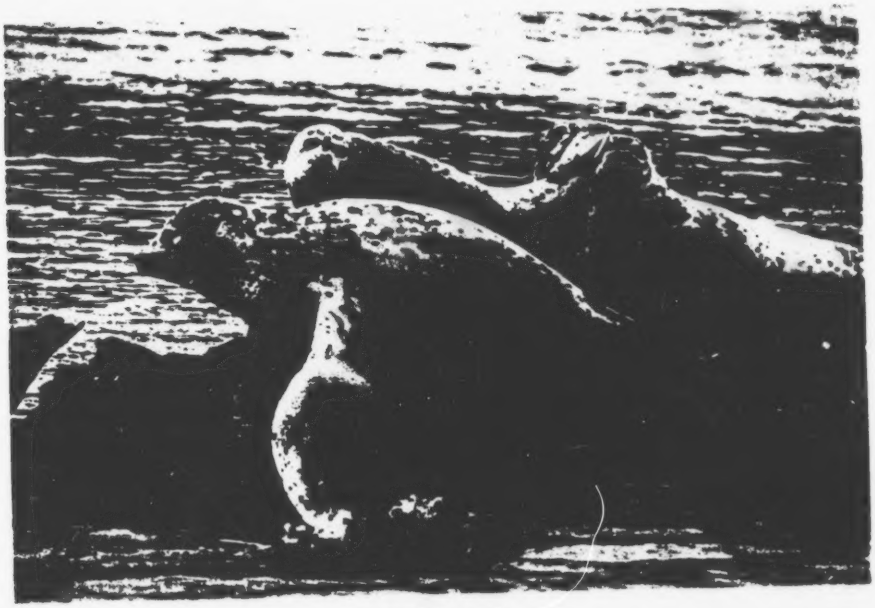
—cumulative environmental effects of various activities;

—the merits of tanker versus pipeline transportation;

—the need to bury pipelines on the seabed;

—the appropriate pipeline landfall; and

—abandonment.



Harbour seals

13. MANAGING FOR ENVIRONMENTAL PROTECTION

Throughout the Panel's review, members of the public expressed concerns about how oil and gas activity would be managed off the west coast. They were particularly anxious that regulation of offshore hydrocarbon exploration on the west coast take into account environmental and social conditions, and the desires and aspirations of local people. Because of these concerns, the Panel scheduled a portion of its public hearings to focus on how the environmental and socio-economic effects resulting from west coast oil and gas exploration could best be managed.

This section:

—describes management systems used elsewhere;

—describes the basic requirements for managing the environmental and socio-economic aspects of future hydrocarbon activity on the west coast;

—considers present regulatory systems; and

—discusses and recommends a system for managing the environmental and socio-economic effects of oil and gas exploration off the west coast of Canada.

EXPERIENCES ELSEWHERE

Management systems have been designed for unique circumstances of various resource developments in various regions of Canada and in other parts of the world. The Panel examined some of these to determine whether any would be applicable to the west coast situation. It found that although none of the examples considered were totally applicable to west coast offshore exploration, features of each could be used in shaping an appropriate system for the west coast. Details of some of these management systems are found in the boxes.

NORTH SEA

Oil and gas exploration and development have been underway in the North Sea for many years. This region is similar to the west coast offshore being isolated, with harsh environments, and with low populations depending substantially on fish and other renewable resources. Both areas have long human occupancies and strong ethnic characteristics. The Shetland Islands, north of Scotland have been a centre of activity. They provide an example both of long-term experience in handling oil and gas impacts and of total local authority over the planning and management of oil and gas activity.

In the Shetland Islands, numerous labour force, land use and other forecasting errors were made, leading to underestimates of housing, schooling and many other development requirements. The Shetland Islanders became aware early of the possible threat of oil and gas development to their traditional way of life and took steps to preserve traditional lifestyles. Nevertheless, many families were affected by increased industrial activity in the area.

While the fishing and oil industries have now learned to coexist in the Shetland Islands, the Shetland experience in its early days was one of conflict, caused by having two users of the seabed with different aims, methods and purposes. Significant problems between the fishing and oil industries have occurred in the areas of safety and navigation, and in the loss of access to traditional fishing grounds.

The 1974 Zetland Act provided the basis for strong local control over offshore petroleum planning activities in the Shetland Islands. Among other things this Act provides for local harbour and shoreline power, local participation in oil development, and pilot and other local levies on tanker use and oil production.

BEAUFORT SEA

Exploration has taken place in the Beaufort Sea and Mackenzie Delta region for over two decades. The Beaufort Sea region is like British Columbia's north coast in some respects. It is remote, culturally diverse, and its large native groups depend on the resources of the sea and land for income, subsistence and cultural strength. Although senior government plays a significant role, strong demands are emerging for greater local input into resource and land management decisions. In the Beaufort Sea a negotiated land claim settlement provides considerable decision-making authority to the aboriginal peoples of the region. Various proposals are now being considered to strengthen regional and community level governments, providing a basis for incorporating local concerns into the management of regional development.

CANADIAN EAST COAST

The Canadian east coast provides an example of a joint jurisdictional, high level management authority. In 1982, the federal government and the Government of Nova Scotia created the Canada-Nova Scotia Offshore Oil and Gas Board to implement managerial responsibilities in Nova Scotia's offshore region. They also established the Canada-Nova Scotia Environmental Coordinating Committee to provide technical advice on environmental matters to the Offshore Oil and Gas Board.

In 1985, the federal government and the Province of Newfoundland and Labrador signed the Atlantic Accord which sets out the principles of joint management of offshore oil and gas resources located in the Newfoundland and Labrador offshore regions. The Accord gives the province final approval over decisions relating to the mode of development. The Government of Canada has final approval over decisions on the pace and mode of exploration, and the pace of development.

A number of specific programs were set up to implement the new management regime created by the Atlantic Accord. A joint Canada-Newfoundland Offshore Petroleum Board was created to make decisions on all matters related to the management of offshore oil and gas resources. This Board will eventually assume the current operational function of the Canada Oil and Gas Lands Administration, and the Newfoundland and Labrador Petroleum Directorate.

An Offshore Development Fund of $300 million was set up jointly by the two governments to help the province develop the infrastructure needed for oil and gas development.

ROBERTS BANK

The Roberts Bank Environmental Assessment Panel in its March 1979 report concluded that the Roberts Bank Coal Port located immediately south of Vancouver, could be expanded subject to further design work to improve the environmental acceptability of the project.

The Panel recommended that Environment Canada "organize the monitoring of the implementation of the recommendations of this Panel." As a result, the Roberts Bank Environmental Review Committee was formed to coordinate environmental input to the planning and design phases of the proposed expansion, and to ensure that the recommendations of the Environmental Assessment Panel were responsibly addressed. This procedure has proven to be successful. It has also proven effective in securing required federal and provincial cooperation in implementing environmental recommendations and adjusting these recommendations in keeping with altered levels of development activity.

COASTAL ZONE MANAGEMENT

In the United States, Coastal Zone Management is a legislated federal program designed to provide money to the state governments to enable them to plan and regulate virtually all economic development in a prescribed area known as the "coastal zone". Much of this planning and regulatory activity is carried out through local county and community governments. The United States "coastal zone" includes not only marine coasts, but the shorelines of major lakes and rivers as well.

The Canadian approach to "coastal zone management" or "shore zone management" is based on the coordination of numerous agencies with varying mandates, and their acceptance of common principles of environmental management with regard to shore zone areas and systems, and coastal related activities. In British Columbia, the British Columbia Ministry of Environment and Environment Canada have taken the lead role in this coordinative approach.

EXISTING MANAGEMENT SYSTEMS

The management structures of the Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources focus primarily on the licensing and control of hydrocarbon exploration and development activities. However, both do have mechanisms and procedures for considering environmental and socio-economic matters. The Canada Oil and Gas Lands Administration has its own environmental and socio-economic staff to provide advice and direction on environmental matters and seeks advice and assistance from other government agencies when it is appropriate to do so. The British Columbia Ministry of Energy, Mines and Petroleum Resources relies on advisory services from the British Columbia Ministry of Environment and other provincial agencies.

The Panel believes that environmental and socio-economic input considered by the regulatory authority should have the same weight as other factors. To achieve this, the existing systems for managing petroleum exploration activity must be altered to ensure that they are integrated with the management of other coastal resources and with community development activities. In addition, the regulatory authority must involve the British Columbia Ministry of Environment, Environment Canada and the Department of Fisheries and Oceans — the main environmental agencies — as managerial partners, not merely as agencies to be consulted.

Furthermore, the Panel is concerned that in a major west coast offshore exploration activity, government may find it difficult to attract and maintain the numbers of highly qualified and experienced personnel it will need to effectively carry out its regulatory responsibilities. The Panel believes that some means must be developed to enable regulatory agencies to retain these people and to overcome the constraints normally experienced by the public service in competing with the private sector.

The unique and sensitive west coast offshore environment requires special measures to ensure its protection. In addition, the depth and extent of public concerns that exist about potential offshore exploration make it essential to provide for the involvement of the local and regional public as full participants in decisions that affect their interests. This involvement must go far beyond merely meeting with groups from time to time to discuss their concerns.

The Panel believes that existing management systems will have difficulty in meeting and fully integrating the special environmental and socio-economic concerns associated with west coast hydrocarbon exploration and in providing a satisfactory mechanism for involving local people. Accordingly, the Panel concludes that an environmental management authority, separate from the regulator's structure but allied intimately to its function, must be created.

> *"... it must be understood that the co-management that we are talking about, is not the co-management the Department of Indian Affairs, the Department of Fisheries, or we'll say the Federal Government, are currently talking about. Co-managment, to them, is an advisory capacity, and co-management to us is the recognition of sovereignty, is that we sit around the table, we sit down as equals." (Wedlidi Speck, Kwakiutl District Council, Fort Rupert, September 1985)*

PROPOSED MANAGEMENT SYSTEM

The overall goals of an environmental management system should be to ensure that the risk and impacts associated with each phase of offshore hydrocarbon activity are minimized and that regional and local economic benefits are maximized.

To achieve these goals, the system must be capable of meeting the following requirements:

1. It must be responsive to the nature and intensity of the exploration activity, which will begin in a small way and may grow over time. Therefore, its structure must be flexible. The management system must recognize and be capable of reacting to the successive thresholds of offshore hydrocarbon activity as they evolve.
2. It must be capable of ensuring coordination between the regulatory authority and other permitting agencies, such as the Canadian Coast Guard and the British Columbia Ministry of Lands, Parks and Housing, and between the regulatory authority and those agencies whose interests are affected by hydrocarbon exploration activity such as the British Columbia Ministry of Environment, Environment Canada, the Department of Fisheries and Oceans, the British Columbia Ministry of Municipal Affairs, the Department of Indian Affairs and Northern Development, municipalities and Indian Bands.
3. It must ensure significant local involvement in regulatory decision-making and planning.

To meet the first requirement, offshore hydrocarbon activity should be divided into two phases: from the present through initial seismic surveying, and from the beginning of exploratory drilling through all subsequent exploration and development. In the first phase, a mechanism for coordinating government activities should be established, supported by an advisory body acting as a conduit for public concerns. In the second phase, a more formalized environmental management body should be established.

To achieve the three criteria for an effective management system, and to ensure effective environmental management, the management bodies operative in each phase should have the authority to:

—advise the regulatory authority on environmental and socio-economic measures and controls to be applied during the various phases of hydrocarbon activities on the west coast;

—coordinate the environmental and socio-economic inputs from various public, private and government agencies;

—ensure local involvement in shaping decisions;

—develop terms of reference for focused environmental and socio-economic project assessments and public reviews, and where appropriate, conduct these assessments and reviews;

—obtain strategic plans, policies and programs from communities and resource agencies;

—ensure that investigations and research related to environmental and socio-economic considerations in ongoing offshore exploration activity are carried out, and are appropriate in terms of need;

—ensure environmental and socio-economic impacts related to ongoing offshore exploration activity are effectively monitored;

—ensure the examination of the cumulative subsea effects of the disposal of drilling muds and cuttings;

—establish mechanisms to ensure that environmental regulations are followed; and

—ensure that appropriate measures for compensation are in place and, in the second phase, appoint an arbitrator or compensation board as required to resolve disputes related to compensation issues.

As offshore exploration activity progresses, circumstances will arise in which many of the original recommendations and concerns of the Panel will no longer be appropriate. A major function of the management body would be to interpret and amend the original recommendations of the Panel in the light of changing circumstances and actual experience gained. However, the major recommendation that a 20 kilometre exclusion zone be established should not be open for revision.

> *"I think it would be in Chevron's interest and also in the areas of interest to look at something like, say, a regional, call it an advisory committee, where you could have people from various communities essentially give them information on your programs, see if there's any concerns. It would also act for you as people going back to the community with an understanding of what's going on." (Walter McClellan, Municipal Clerk, District of Kitimat, Kitimat, September 1985)*

ENVIRONMENTAL COORDINATING COMMITTEE

Since the implementation of many of the Panel's recommendations will become the responsibility of various agencies and bodies, a mechanism for coordinating their implementation needs to be established.

The Panel believes that a committee similar to the Roberts Bank Environmental Review Committee should be constituted immediately to oversee the implementation of recommendations applicable during the first period of exploration activity and to carry out the required central environmental management responsibilities during that time.

The Panel recommends that a West Coast Offshore Petroleum Environmental Coordinating Committee be established immediately to ensure that the Panel's recommendations relevant to the early stages of offshore hydrocarbon activity are implemented.

The Panel recommends that the West Coast Offshore Petroleum Environmental Coordinating Committee be created under the authority of the federal and British Columbia Ministers of Environment and include representation from the British Columbia Ministry of Environment, Environment Canada (Pacific and Yukon Region), the Department of Fisheries and Oceans (Pacific and Yukon Region), the British Columbia Ministry of Municipal Affairs, the Department of Indian Affairs and Northern Development (British Columbia Region), the Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources. It should report to the two Ministers of Environment on a semi-annual basis and at threshold points throughout the early stages of exploration activity.

In addition to meeting the requirements for the environmental management system previously identified by the Panel, a mandate for the Environmental Coordinating Committee should include the following activities:

1. Provide advice to the regulatory authority and operators on environmental planning and design matters.
2. Present research programs recommended by the Panel, and further developed by this Environmental Coordinating Committee, to appropriate funding sources such as the Environmental Studies Revolving Fund, and monitor the progress of such research.
3. Ensure that computer based mapping and data banks are established, managed and updated.

PUBLIC ADVISORY COMMITTEE

The Environmental Coordinating Committee and the regulatory authority must be provided with the advice and concerns of the public in the region and, in turn, must regularly inform the public of the nature and progress of offshore exploration activities.

> **The Panel recommends that a three-person Public Advisory Committee be appointed by the federal and British Columbia Ministers of Environment. This Committee will be charged with advising the regulatory authority and the Environmental Coordinating Committee about public concerns and with undertaking public information and education programs. Representation on this Committee should include local, native and fishing interests.**

The Public Advisory Committee's overall objective is to inform and educate the public, receive local knowledge, determine local concerns, and identify and mitigate or avoid problems.

The responsibilities of the Public Advisory Committee should include the following:

—conducting public information and education programs including the publication of newsletters, eventually establishing local information offices, and conducting field and community visits;

—coordinating public information and participation efforts between and among the regulatory authority, operators, the Environmental Coordinating Committee and other involved agencies;

—meeting regularly with the regulatory authority, with the operator and with the Environmental Coordinating Committee to provide information on public concerns, provide advice on research and monitoring, and receive information on current activities;

—overseeing the socio-economic monitoring efforts; and

—providing an annual report to the Ministers of Environment regarding the state of these affairs.

Public information and education programs should have the following characteristics:

1. all relevant information should be objective and available locally in a form that can be easily understood; and
2. information should include specific details that would be useful to local residents such as the scale, location, equipment and procedures of offshore exploration, the possible effects on resources and communities, sources of further information and opportunities to participate.

The Environmental Coordinating Committee and the Public Advisory Committee should be provided with a coordinator and with appropriate operating funds.

These two bodies should carry out their functions within the management system from the time of acceptance of this report through the period of seismic exploration, to such time as a proposal for exploratory drilling is received by the regulatory authority. Should plans for offshore exploration cease, the Environmental Coordinating Committee and Public Advisory Committee would be disbanded.

ENVIRONMENTAL MANAGEMENT AUTHORITY

At the time an application to drill is received, it will be clear that the offshore exploration activity is embarking upon a new, more sustained and more significant phase. At this point, interim arrangements put in place during the earlier and more uncertain phases of exploration should become subsumed under a more permanent management structure.

> **The Panel recommends that a West Coast Offshore Petroleum Environmental Management Authority be appointed and assume its duties at such time as the first proposal for exploratory drilling is received by the regulatory authority.**

> **The Panel recommends that the membership of the Management Authority shall comprise five representatives of the regional public appointed jointly by the Ministers of Environment for Canada and British Columbia upon nomination by the Offshore Alliance of Aboriginal Nations, the north coast grouping of the Union of British Columbia Municipalities, the British Columbia Ministry of Environment, Environment Canada and the Department of Fisheries and Oceans.**

This body should officially assume authority for all activities conducted by the Environmental Coordinating Committee and the Public Advisory Committee and shall be responsible for overseeing and guiding the regulatory authority's environmental and socio-economic activities.

The Environmental Coordinating Committee and the Public Advisory Committee should serve as advisors and operating arms of the Environmental Management Authority. The Environmental Management Authority should be provided with a full time coordinator, office support staff and appropriate operating funds.

14. ACTION PLAN

This section lays out an action plan for undertaking the various activities required to manage the environmental and socio-economic effects of west coast offshore hydrocarbon exploration.

STAGES OF HYDROCARBON ACTIVITY

The Panel has identified the following stages for implementation of its recommendations:

—before seismic surveying begins;

—before exploratory drilling begins;

—after an initial discovery and before completion of delineation drilling; and

—during the development and production stages.

If seismic surveys identify several potential structural traps, these stages could begin in different locations at different times, so the actions proposed for each stage would come into effect at different times.

RECOMMENDATIONS AND ACTIONS WHICH RELATE TO THE PERIOD PRIOR TO SEISMIC SURVEYING

The following general recommendations are to be acted upon during this phase:

Actions

—Establish a West Coast Offshore Petroleum Environmental Coordinating Committee;

—Establish a West Coast Offshore Petroleum Public Advisory Committee;

—Implement areal, seasonal and technical constraints for seismic surveying;

—Initiate communications between seismic operators and the fishing industry, including the preparation of information booklets on regional fishing techniques and practices and seismic survey operations;

—Initiate an ongoing public information and education program, including provision of information on seismic surveying, timing and routes;

—Design and implement monitoring and surveillance programs for seismic surveying including measures to ensure that the data from these programs are used to determine the effects of continued seismic survey operations;

—Upgrade regulations on seismic surveying in accordance with monitoring and research results; and

—Design and implement compensation arrangements appropriate to seismic surveying.

Research

—Design and initiate research programs to be undertaken in conjunction with the operation of the seismic survey vessel to determine the nature and extent of lethal and sublethal effects of seismic operations on marine biota, particularly ichthyoplankton and juvenile fish.

RECOMMENDATIONS AND ACTIONS WHICH RELATE TO THE APPROVAL OF EXPLORATORY DRILLING

The time available during initial seismic surveying must be used to acquire sufficient knowledge about the marine biophysical and socio-economic environment to allow the potential impacts of any site-specific drilling proposal in the region to be assessed confidently and to allow appropriate terms and conditions for dealing with these potential impacts to be specified.

The following recommendations are to be acted upon before exploratory drilling is approved:

Actions

—Establish a West Coast Offshore Petroleum Environmental Management Authority;

—Implement temporal and spatial restrictions, and operational and design requirements, on exploratory drilling operations;

—Develop and put in place oil spill contingency plans of both industry and government;

—Improve storm prediction ability to provide a minimum of six hours advance warning of severe storms;

—Ensure that the capacity of the Canadian Coast Guard to respond effectively to offshore oil spills is upgraded;

—Develop and put in place contingency plans for managing the commercial fishery in the event of a major oil blowout;

—Ensure that provisions are made for drilling relief wells;

—Monitor marine traffic in the region, and when necessary, design and implement a marine traffic management system;

—Implement drilling mud restrictions;

—Ensure that adequate spill prevention and cleanup equipment is available to deal with possible spills of toxic materials during transfer operations;

—Develop strategies for the use of dispersants and incorporate them into the contingency plans of government and industry;

—Implement aircraft and support vessel routing and operational guidelines;

—Ensure that biological monitoring and surveillance programs are upgraded appropriately;

—Initiate monitoring of the effects of rig lighting on birds;

—Ensure that arrangements are in place to regularly test and evaluate operator and government contingency plans;

—Initiate a program to monitor socio-economic effects;

—Implement public information and education programs;

—Ensure that compensation programs and the means for their administration are upgraded to a level appropriate to that required to deal with possible damage to property, income and resources during exploratory drilling; and

—Conduct site specific public reviews of proposed drilling programs, if necessary.

The decision as to whether public reviews would be necessary to evaluate drilling applications and the nature of such reviews can only be made by the Environmental Management Authority after it has considered the proximity of the proposed drilling to other marine resource users, the possible impacts on biota and the possible socio-economic impacts.

Research

—Ensure that the coastal sensitivity mapping begun under the Environmental Studies Revolving Fund is expanded and that it includes data on the native food fishery, and ensure that this program is maintained jointly by industry, the Department of Fisheries and Oceans and the British Columbia Ministry of Environment;

—Ensure that an inventory of archaeological and cultural sites vulnerable to oil blowout damage is completed;

—Improve significantly the quality and quantity of information relating to native food fisheries in the region;

—Ensure that the Department of Fisheries and Ocean's subsurface current studies are continued in the vicinity of drilling sites, and that surface currents as well as wind data are included in trajectory models used for contingency planning;

—Initiate a major research program to determine the sublethal effects of naturally and artificially dispersed crude oil on the critical life stages of migrating salmonid species;

—Identify the locations, species and numbers of seabirds in, and the use made of, mainland coastal seabird colonies bordering Hecate Strait and Queen Charlotte Sound; and

—Develop a comprehensive research program designed to reduce data gaps necessary to develop a credible model of the impact of an oil blowout on important fish species at their various life stages.

RECOMMENDATIONS AND ACTIONS RELATED TO THE PERIOD FOLLOWING THE DISCOVERY OF HYDROCARBONS AND BEFORE THE COMPLETION OF DELINEATION DRILLING

At this stage of hydrocarbon activity, the future production of oil or gas is a real possibility. At least three to four years will have elapsed since the beginning of seismic exploration. The issues related to the production of offshore hydrocarbons are substantial and differ to some extent from those related to exploration.

The approach to this activity must be thoroughly planned, since the possible introduction of a major industry into the region may bring significant social problems as well as benefits.

At this point, the Environmental Management Authority will have to consider the level and quality of information needed to prepare for production and development.

RECOMMENDATIONS AND ACTIONS THAT RELATE TO DEVELOPMENT AND PRODUCTION

Following the definition of a commercial discovery and before development and production approvals are granted, the Environmental Management Authority should:

—Develop focused guidelines to assess potential environmental and socio-economic impacts of proposed developments;

—Evaluate the applicability of research conducted throughout the exploration phase, to the assessment and management of development and production;

—Complete full formal public reviews of production and development proposals; and

—Ensure that the public has been fully informed regarding these procedures and potential developments.

15. SUMMARY OF RECOMMENDATIONS

The following is a restatement of each of the Panel's recommendations as contained in the main body of the report. For ease of reference, the recommendations are listed section by section.

PROCESS

The Panel recommends that public environmental assessment reviews of broad industrial activities proposed within large geographic regions be conducted in such a manner that government, through interdepartmental coordination, be required to prepare the environmental impact statement, and to present this information in the appropriate forum for public review.

The Panel recommends that a specific proponent not be designated for environmental assessment reviews unless the regulatory agencies have the capacity to enforce the proponent's continued participation.

The Panel recommends that:

1. **The Governments of Canada and British Columbia develop policies on intervenor funding for formal public reviews that will enable funds to be made available to communities and organizations to participate effectively in public review processes; and**
2. **financial assistance be directed to communities and groups to help them analyze and understand existing information, to develop and articulate positions and concerns, and to organize and present their own briefs.**

ISSUES AND KEY RECOMMENDATIONS

The Panel recommends that the regulatory authority ensure, as a paramount priority, a high level of training, experience and competence for drilling personnel and the highest standard of equipment; also that frequent inspections of systems, equipment, and personnel are carried out, and that a satisfactory level of weather forecasting is available to drilling operations.

The Panel recommends that drilling be prohibited within an exclusion zone of 20 km from any point of land for the protection of important marine life in the event of an offshore oil blowout.

The Panel recommends that exploratory drilling operations outside the 20 km exclusion zone be initially confined to the months of June to October inclusive to ensure weather more favourable to drilling operations, to mitigate the likelihood of an oil blowout and to protect important biological species during critical phases of their life cycles.

The Panel recommends that a mechanism be established to ensure participation of the public of the region, in ways acceptable to them, in the management and decision-making related to offshore hydrocarbon exploration.

The Panel recommends that in designing programs and mechanisms for the involvement of the public of the region in the management and decision-making relating to offshore hydrocarbon exploration and its impact on marine resources, government develop means to ensure aboriginal peoples are involved.

The Panel recommends that a government compensation policy covering all stages in an exploration program be established before exploration activity begins.

SEISMIC SURVEYING

The Panel recommends that:

1. **a seismic survey program such as that proposed by Chevron be permitted to proceed, providing that half the program is conducted in the first year of operation and the remainder in the second year;**
2. **the program be conducted with no less than a 3-km line spacing pattern, and a maximum survey length of 5,200 km;**
3. **during both seasons of seismic surveying, the Department of Fisheries and Oceans carry out extensive monitoring and experimentation in conjunction with the seismic survey vessel to determine the nature and extent of any resulting damage;**
4. **such data collection and experimentation be used by the regulatory authority to determine the likely long-term effects of seismic operations on marine biota, particularly eggs and larvae, and be applied in determining the appropriate controls and regulations to any future seismic surveys; and**
5. **until such time as the results of monitoring and experimentation have been evaluated, no other marine seismic survey operations be permitted.**

The Panel recommends that during the sensitive gray whale migration and herring spawning periods of March, April, May, November and December, seismic operations not occur within 10 km of shore.

The Panel recommends that when marine mammals are observed within 2 km of the airgun array, the survey temporarily cease until the mammals have moved out of the area.

The Panel recommends that, for purposes of general operations, seismic surveying be restricted to airguns only.

The Panel recommends that where the use of explosives in shallow water seismic surveys is required to connect land and sea surveys, approval only be granted where:

1. there are no alternatives;
2. explosives are buried within boreholes within the sea floor; and
3. the program is subjected to specific approval from the Department of Fisheries and Oceans as to timing and location.

The Panel recommends that booklets be produced and widely distributed describing the fishing techniques employed on the British Columbia coast, illustrating the different methods and seasons used to catch fish and shellfish, and describing seismic survey operations.

The Panel recommends that the operators of the seismic vessels meet with the members of the fishing industry before surveying begins to identify potential heavy fishing areas and seasons and to familiarize themselves with the local fishing equipment and techniques.

ROUTINE EXPLORATORY DRILLING AND SUPPORT OPERATIONS

The Panel recommends that regulatory authority not give approval to drill until the Atmospheric Environment Service of Environment Canada is satisfied that the capability exists to provide a minimum of 6 hours advance warning of severe storms to enable an offshore drilling operator sufficient time to safely and efficiently disconnect from the wellhead.

The Panel recommends that the Department of Fisheries and Oceans develop and implement a program to improve general knowledge of current movements in the region, and in particular, in the area of a drilling location when one is proposed.

The Panel recommends that before drilling occurs, a proposed site must be evaluated by the operator and the regulatory authority for its potential susceptibility to earthquake-induced turbidity flows, and that if the potential exists, wellhead design will be such that the well remains safely shut-in.

The Panel recommends that operators be required to undertake an extensive site survey of the seabed, including a seismic sparker survey, when investigating an area for a specific drilling location.

The Panel recommends that only chrome-free lignosulphonate be used for drilling muds in offshore exploratory drilling operations on the west coast.

The Panel recommends that the regulatory authority require industry to use only those drilling mud products with low to zero heavy metal content, and that industry routinely sample their supplies to ensure the approved standards are maintained.

The Panel recommends that, to reduce the need to use oil as a spotting fluid to free stuck drill collars, spiral or straight grooved drill collars be used for all drilling operations.

The Panel recommends that if oil must be used to free collars, mineral oil or another nontoxic type of oil be used.

The Panel recommends, under special circumstances requiring the use of oil-based drilling muds, that:

1. only mineral oil-based muds be used;
2. a closed system be used in which no oil-based drilling muds are released into the sea; and
3. the amount of oil adhering to the cuttings be minimized by jet washing at the shale shaker and by collecting the oil.

The Panel recommends that, to minimize disturbance to marine mammals and birds from aircraft noise, the Canadian Wildlife Service of Environment Canada and the British Columbia Ministry of Environment develop guidelines to prevent disturbances to sensitive species, and that these guidelines be followed by aircraft operators involved in the west coast offshore exploration program.

The Panel recommends that Transport Canada develop a mechanism to ensure that flight constraints around sensitive marine mammal and bird areas be applied to all aircraft operators in the area.

The Panel recommends that:

1. **where feasible, drill rig marking lights consist of high intensity strobe or other types of intermittent lights;**
2. **working lights be masked or shielded to minimize outward illumination; and**
3. **the attraction of birds to rig lights be monitored and reports published monthly on bird kills so that data is collected to better evaluate and mitigate potential problems.**

The Panel recommends that during the exploration phase of offshore oil and gas activity, shorebase facilities be developed within the industrial zones of existing communities.

The Panel recommends that where sediment removal processes are evident at a drill site, the wellhead cut-off point below the seabottom be increased to three metres.

The Panel recommends that the Canadian Coast Guard closely monitor any increase in ship traffic and, if and when offshore drilling is approved, develop and enforce the use of a marine traffic management system in the region.

SOCIO-ECONOMIC EFFECTS OF ROUTINE OPERATIONS

The Panel recommends that, in the event of expanded exploration, the Department of Indian Affairs and Northern Development and the British Columbia Ministry of Municipal Affairs provide funding and other assistance to potentially affected communities so that these communities can initiate ongoing monitoring programs related to the socio-economic effects of offshore hydrocarbon exploration and initiate programs to deal with these effects.

The Panel recommends that a public information and education program be initiated immediately through consultation with area residents, industry and the regulatory authority.

The Panel recommends that, as a condition of obtaining an Exploration Agreement, an operator establish a preferential hiring policy for employing local residents assuming equivalent skills, and that the operator ensure contractors follow the same policy.

The Panel recommends that government and industry review existing training programs, and if exploration activity is expanded, implement training to enable local residents to qualify for offshore petroleum-related jobs.

The Panel recommends that industry, in an expanded exploration program, develop programs in consultation with area residents that would enable them to pursue, as far as possible, traditional activities while employed in offshore exploration.

The Panel recommends that, as a condition of obtaining an Exploration Agreement, an operator establish policies giving preference to local suppliers of goods and services, and that the operator ensure contractors follow the same policy.

HYDROCARBON BLOWOUTS

The Panel recommends that the regulatory authority not approve the drilling of any exploratory well until the operator has proven that formal arrangements are in place to bring in a relief well drilling unit to a blowout site and begin drilling a relief well within 14 days of a decision to mobilize, regardless of inclement weather or other inhibiting factors. The arrangements to start mobilizing a relief well unit are to be put into action within 48 hours of the start of a blowout.

The Panel recommends that, before exploratory drilling begins, the regulatory authority take steps to:

1. **directly assess the experience, training, testing, and supervisory capabilities of drilling personnel;**
2. **ensure the best quality equipment, meeting the toughest standards of design, is used in all drilling and well-control operations;**
3. **develop effective surveillance, inspection and enforcement programs and practices related to well control, and ensure that these programs and practices are carried out in a thorough and timely manner; and**
4. **ensure that programs include frequent, unannounced inspections and exercises to ensure that appropriate drilling procedures, standards and regulations are being met, and to verify that drilling personnel and equipment are prepared for responding to drilling emergencies and blowouts.**

THE FATE AND EFFECTS OF OIL IN THE MARINE ENVIRONMENT

The Panel recommends that the Department of Fisheries and Oceans conduct research to determine the lethal and sublethal effects of naturally and artificially dispersed crude oil on critical life stages of migrating salmonid species.

The Panel recommends that the Department of Fisheries and Oceans, in cooperation with other agencies, develop a comprehensive research program designed to reduce data gaps necessary to develop a credible model of the impact of an oil blowout on important fish species at their various life stages.

The Panel recommends that, in the event of a blowout, the Department of Fisheries and Oceans be prepared to immediately initiate a major research and monitoring program to gather information on the actual concentrations of dispersed oil in the water column and the lethal and sublethal effects on important west coast species, particularly salmon and herring, at critical life stages, in order to assess more accurately the effects of oil on these species.

The Panel recommends that, before exploratory drilling begins, Environment Canada (Canadian Wildlife Service), assisted by appropriate provincial agencies, undertake inventory surveys of the coastline of the region as well as adjacent shelf waters, to establish baseline information on the population, location and behaviour of coastal bird species for contingency planning purposes.

The Panel recommends that the operator, as part of its oil blowout contingency plan, identify experts on bird cleaning who will be available on call to direct local efforts to clean oiled birds.

The Panel recommends that programs be undertaken to improve the quality and quantity of information related to native food fisheries in the region.

The Panel recommends that, before exploratory drilling begins, the Department of Fisheries and Oceans develop a contingency plan for managing the commercial fishery after a blowout, including monitoring of fish for tainting and administration of closures.

OIL BLOWOUT CONTINGENCY PLANNING AND COUNTERMEASURES

The Panel recommends that, before exploratory drilling is approved, the regulatory authority ensure that:

1. **coastal sensitivity mapping begun under the Environmental Studies Revolving Fund is expanded to cover areas that are inadequately mapped;**
2. **the native food fishery and resource harvesting activity are included within this mapping, with native people involved in acquiring and developing this information;**
3. **arrangements are in place to ensure that sensitivity mapping is maintained and updated jointly by the British Columbia Ministry of Environment, Environment Canada, the Department of Fisheries and Oceans and industry; and**
4. **the Heritage Conservation Branch of the Government of British Columbia complete an inventory of archaeological and cultural sites vulnerable to oil and ensure that measures to protect these sites from inappropriate cleanup procedures are included in contingency plans.**

The Panel recommends that, in the event of a blowout:

1. **the Canadian Coast Guard coordinate government involvement in responses to an oil spill resulting from a blowout; and**
2. **the Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources coordinate government responsibilities for rig-related actions to control blowouts.**

The Panel recommends that the regulatory authority ensure the establishment of programs to train, organize and equip local residents for participation in oil spill countermeasures and cleanup.

The Panel recommends that, before exploratory drilling is approved, the regulatory authority ensure that arrangements are in place to regularly test and evaluate operator and government contingency plans.

The Panel recommends that the regulatory authority ensure that at least one full scale oil blowout response practice exercise is carried out during the initial exploration period, and if an extended exploration program takes place, that at least one exercise is carried out each year.

The Panel recommends that, before exploratory drilling is approved, the regulatory authority require operators to provide detailed descriptions of:

1. **the monitoring and surveillance procedures and equipment that would be used to monitor the location of slicks from a blowout;**
2. **the location and availability of equipment and how it would be deployed; and**
3. **the adequacy of these procedures and equipment for use in tracking slicks from a blowout at the specific drilling site.**

The Panel recommends that at least one year before exploratory drilling begins, the Department of Fisheries and Oceans, in cooperation with industry, implement a surface current measuring program in the region of the drilling site, and that industry include surface current effects for the purpose of developing contingency plans.

The Panel recommends that during oil spill countermeasure operations, emphasis be placed on the use of radio-located tracking buoys as sensors to provide position updates for oil slick tracking.

The Panel recommends, that before exploratory drilling is approved, the Canadian Coast Guard upgrade its resources for responding effectively to offshore oil spills, including trained personnel, modern equipment, depots, communications systems, and the logistical capability to deploy these resources quickly.

The Panel recommends, before exploratory drilling begins, that:

1. **Environment Canada and the British Columbia Ministry of Environment clarify the circumstances under which their respective governments would permit or prohibit the use of dispersants, and in cooperation with industry, develop a strategy for the use of dispersants if these are not prohibited; and**
2. **operators incorporate this dispersant strategy into their contingency plans.**

The Panel recommends that, before exploratory drilling is approved, operators include specific strategies in their contingency plans, for cleaning up shorelines that are vulnerable to oil from a blowout at the a proposed drilling site, including details on the types and availability of equipment that would be used, manpower requirements, training provisions, operational logistics and guidelines for cleaning up individual shoreline areas.

COMPENSATION

The Panel recommends that a government compensation policy covering all stages in an exploration program be established before exploration activity begins, and that this policy be based upon the following basic principles:

1. **Compensation is to be provided for situations involving loss of, or damage to, property and equipment.**
2. **Compensation is to be provided for situations involving loss of income.**
3. **Compensation is to be provided for situations involving loss of, or damage to, common property resources.**
4. **Attributable and nonattributable damages and losses are to be covered.**
5. **The burden of proof in any dispute over compensation for damages or income loss is to rest with the oil companies rather than the claimant; the onus is to be on the companies to support their disclaimer "on the balance of probability."**
6. **As both the oil industry and government will share in benefits to be gained from the exploration program, both should share in the financial responsibility for any common property resource losses or damages incurred.**
7. **Compensation programs relating to common property resource losses should emphasize replacement of the resource rather than financial compensation.**

The Panel recommends that any disputes arising out of compensation claims relating to routine operations that cannot be resolved between the two parties be referred to third party arbitration.

The Panel recommends that a policy for compensating losses and damage resulting from significant oil well blowouts, following the basic principles set out by the Panel and containing the elements outlined by the Panel, be in place before any exploration drilling begins.

The Panel recommends that before any drilling begins, each operator be required to post a $40 million bond or irrevocable letter of credit.

The Panel recommends that government accept a financial liability of $10 million towards any resource rehabilitation programs that are found necessary to replace resources lost from an oil well blowout.

The Panel recommends that the absolute financial liabilities to be borne by the operator and government for resource rehabilitation programs not exceed $20 million to be borne equally by government and the operator.

The Panel recommends that in the event of a blowout, the need for resource rehabilitation programs be determined by government, and that these programs be designed and implemented by the appropriate government agencies.

The Panel recommends that a West Coast Offshore Compensation Board be appointed if and when a significant oil well blowout occurs.

The Panel recommends that the West Coast Offshore Compensation Board consist of at least three members, include equal representation from the oil industry and the fishing industry, and be headed by an independent Chairman.

MANAGING FOR ENVIRONMENTAL PROTECTION

The Panel recommends that a West Coast Offshore Petroleum Environmental Coordinating Committee be established immediately to ensure that the Panel's recommendations relevant to the early stages of offshore hydrocarbon activity are implemented.

The Panel recommends that the West Coast Offshore Petroleum Environmental Coordinating Committee be created under the authority of the federal and British Columbia Ministers of Environment and include representation from the British Columbia Ministry of Environment, Environment Canada (Pacific and Yukon Region), the Department of Fisheries and Oceans (Pacific and Yukon Region), the British Columbia Ministry of Municipal Affairs, the Department of Indian Affairs and Northern Development (British Columbia Region), the Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources. It should report to the two Ministers of Environment on a semi-annual basis and at threshold points throughout the early stages of exploration activity.

The Panel recommends that a three-person Public Advisory Committee be appointed by the federal and British Columbia Ministers of Environment. This Committee will be charged with advising the regulatory authority and the Environmental Coordinating Committee about public concerns and with undertaking public information and education programs. Representation on this Committee should include local, native and fishing interests.

The Panel recommends that a West Coast Offshore Petroleum Environmental Management Authority be appointed and assume its duties at such time as the first proposal for exploratory drilling is received by the regulatory authority.

The Panel recommends that the membership of the Management Authority shall comprise five representatives of the regional public appointed jointly by the Ministers of Environment for Canada and British Columbia upon nomination by the Offshore Alliance of Aboriginal Nations, the north coast grouping of the Union of British Columbia Municipalities, the British Columbia Ministry of Environment, Environment Canada and the Department of Fisheries and Oceans.

WEST COAST OFFSHORE EXPLORATION ENVIRONMENTAL ASSESSMENT PANEL

Ewan Cotterill
EWAN COTTERILL (Chairman)

Bellis
Charlie Bellis

Peter Gelpke
Peter Gelpke

Allen R. Milne
Allen Milne

Norman (Sonny) Nelson

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APPENDIX A

PANEL TERMS OF REFERENCE

INTRODUCTION

In keeping with the Memorandum of Agreement signed by the Governments of Canada and British Columbia on September 8, 1983, the Panel is to conduct a formal public review of the environmental and directly related socio-economic consequences of offshore hydrocarbon exploration in the Agreement area, north of Vancouver Island. This review is necessary before any consideration can be given to lifting the federal and provincial moratoria on exploration in the area.

The Panel shall operate under a joint framework established under the federal Environmental Assessment and Review Process and the provincial Environment Management Act. Chevron Canada Resources Limited has been designated as the proponent in the Hecate Strait, Queen Charlotte Sound and Queen Charlotte Strait areas for the purposes of the review.

SECRETARIAT

The Federal Environmental Assessment Review Office and the provincial Ministry of Environment shall provide both the budget and secretariat to the Panel.

PANEL MANDATE

The mandate of the Panel shall be to review and assess the environmental and directly related socio-economic effects of offshore hydrocarbon exploration in the Agreement area and to present recommendations to the federal and provincial Ministers of Environment on the terms and conditions under which hydrocarbon exploration could proceed in a safe and environmentally responsible manner. In fulfilling its mandate, the Panel shall provide adequate opportunity for public review of the proposed exploration projects in order to ensure that all environmental and directly related socio-economic considerations are accounted for.

EXEMPTIONS

The Panel shall preclude from its review questions of energy policy, jurisdiction or land claims. Issues concerning the production and development phase will not form part of this review although such issues as they relate to these phases may be identified for future public review should exploration lead to a commercial discovery.

SCOPE OF PANEL REVIEW

The objective of the review is to recommend the terms and conditions under which exploration might proceed in a safe and environmentally responsible manner, should a decision be made to resume exploratory drilling activity.

In this context, as background to the review, the Panel should receive information on:

1. the general offshore geology and areas of hydrocarbon potential;
2. the nature and extent of exploration activities anticipated to be undertaken in the areas of interest; and
3. the relevant biophysical phenomena and socio-economic issues found in the area of interest.

The Panel review shall address:

1. the potential effects of the marine environment on offshore exploration activity;
2. the environmental and directly related socio-economic effects of offshore exploration activity on coastal and marine environments and the uses thereof; and,
3. the significance of the effects identified in 1. and 2. above, and measures of dealing with these effects.

REPORT AND RECOMMENDATIONS

The Panel shall submit a report of its findings to the federal and provincial Ministers of Environment; the Panel's report shall be submitted on or before November 30, 1985.

The report shall include:

1. seasonal and regional concerns associated with offshore exploration;
2. where appropriate, an identification of information gaps which may prevent a full assessment of impacts and risks prior to commencement of exploration; and,
3. recommendations on the terms and conditions under which exploration might proceed in a safe and environmentally responsible manner, should a decision be made to resume exploratory drilling activity.

The Panel is invited to provide additional information on related subjects which are consistent with these Terms of Reference.

PANEL REVIEW PROCESS

In the process of the public review, public hearings should be conducted in a non-judicial but structured manner to allow examination of information presented to the Panel.

The main components of the Panel Review shall be as follows:

1. Initial Environmental Evaluations (IEEs) from Petro-Canada and Chevron and other supporting documentation, including the results of the Technical Evaluation, shall be submitted to the Panel and made available to the public;
2. based on its examination of this documentation and public comment the Panel shall ask for additional information if necessary; and
3. the documents noted above, plus the supplemental information asked for by the Panel shall constitute the "Environmental Impact Statement" for purposes of this public review.

PROCEDURES

Detailed written procedures for the conduct of the review shall be established by the Panel and made available to the public.

APPENDIX B

PANEL MEMBER BIOGRAPHIES

MR. EWAN COTTERILL (CHAIRMAN)

Mr. Cotterill is a consultant in public affairs and resource management. He has extensive experience with northern resource development as a senior federal civil servant and as an executive with the oil industry. He is well acquainted with native and community interests. He is a former Assistant Deputy Minister in the federal Department of Indian Affairs and Northern Development and was Assistant Commissioner of the Northwest Territories. Mr. Cotterill has also served as Executive Chairman of the Federal Environmental Assessment Review Office. Most recently, he was a Vice President of Dome Petroleum Ltd. and was a chairman of the Arctic Petroleum Operators' Association.

MR. CHARLIE BELLIS

Mr. Bellis has lived and worked on the Queen Charlotte Islands all his life. He has spent many years working as a commercial fisherman and owns his own fishing boat. He is a past director of the Council of the Haida Nation and currently lives in Masset. Mr. Bellis also ran a tugboat on the Queen Charlotte Islands for eight years, engineered on a crab boat and has been a member of the Fishery Advisory Committee to the Department of Fisheries and Oceans for ten years. He has also been on the Board of Directors for the Credit Union in Masset and is the Fisheries Coordinator for the Council of the Haida Nation.

MR. PETER GELPKE

Mr. Gelpke is a petroleum engineer and executive with thirty-eight years of experience in the exploration and production sectors of the oil and gas industry, both in the domestic and international fields. He has held senior engineering and management positions working for Shell, Total and Mobil companies in many areas of the world, and for Trafalgar House and the Comex Group in Europe. His work has included involvement with all aspects of offshore exploration and production programs in the Middle East, Far East and North Sea. Mr. Gelpke returned to Canada three years ago and now lives in West Vancouver where he operates a small consulting business. He is a registered Professional Engineer in the Provinces of British Columbia and Alberta.

MR. ALLEN MILNE

Mr. Milne is a scientist and oceanographer now living in Sidney, British Columbia. His career included 29 years with the federal government, primarily in British Columbia, where he was involved with scientific research and oceanographic studies. Prior to leaving the government in 1979, he spent five years as Head of Arctic Marine Sciences at the Pat Bay Institute of Ocean Sciences. Since 1979, he has undertaken a number of consulting assignments including the conduct of environmental impact studies relating to oil and gas development in the Canadian Beaufort Sea area.

MR. NORMAN (SONNY) NELSON

Mr. Nelson has over 25 years of management experience in British Columbia's fishing industry. After having managed fishing operations in Vancouver, Prince Rupert and Alaska, Mr. Nelson joined British Columbia Packers where he became Vice President of Pacific Operations and was elected to their Board of Directors (1977-1983). Since 1980 Mr. Nelson has functioned as a Fisheries Consultant to British Columbia Packers. Mr. Nelson currently resides in West Vancouver.

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APPENDIX C

TECHNICAL SPECIALISTS BIOGRAPHIES

DR. JAMES DARLING — MARINE MAMMALS

Dr. Darling has a B.Sc. in Biology (1972) and a M.Sc. in Zoology (1978) from the University of Victoria, and a Ph.D. in Biology (1983) from the University of California. He is currently Executive Director of the West Coast Whale Research Foundation (an association of whale researchers in Canada and the United States). Most of his professional experience is related to whale research and has included work for the International Whaling Commission and the World Wildlife Fund.

Dr. Darling replaced Dr. John Ford as the Panel's technical specialist on marine mammals in mid-October 1985.

MS. DIANE ERICKSON — SOCIAL & COMMUNITY IMPACTS

Ms. Erickson is a social impact assessment consultant now living in Victoria. Her work experience includes acting as a consultant to the Town of Inuvik on the potential impacts on municipal responsibilities of proposed oil and gas development in the Beaufort Sea area. She has also been involved in a number of social impact studies in British Columbia. She has a B.A. in Sociology (1969) from York University and a M.A. in Sociology (1974) from the University of British Columbia.

DR. JOHN FORD — MARINE MAMMALS

Dr. Ford obtained his Ph.D. in Zoology from the University of British Columbia in 1985. He is currently on a two year visiting fellowship with the Pacific Biological Station (Department of Fisheries and Oceans) in Nanaimo involved in marine mammals research. He is also involved in work with the West Coast Whale Research Foundation. He has undertaken many field investigations and studies of marine mammals (mainly whales) in the Canadian Arctic and west coast waters.

Dr. Ford stepped down as a technical specialist on marine mammals in early October 1985 because of a potential conflict of interest with his current responsibilities with the Department of Fisheries and Oceans. He was replaced by Dr. Jim Darling.

MR. DAVID FISSEL — PHYSICAL OCEANOGRAPHY

Mr. Fissel obtained a M.Sc. in Oceanography from the University of British Columbia in 1975. Following graduation, he was employed, on a contractual basis, as a physical oceanographer at the Institute of Ocean Sciences in Victoria, British Columbia. He conducted a year-long study of currents and cross-channel pressure differences in Juan de Fuca Strait and played a major role in studies of the circulation of the eastern portion of the Northwest Passage. He joined Arctic Sciences Ltd. in Sidney, British Columbia as a Founding Member in April 1977. He has directed the company's major two-year study of the physical oceanography of western Baffin Bay, along with a follow-up study in 1980. More recently, Mr. Fissel has directed an oceanographic survey of the Canadian Arctic Archipelago in the spring of 1982 and 1983; studies of the currents in the Canadian Beaufort Sea in 1981 and 1982; and ongoing analysis of satellite-tracked drifter data off Labrador in 1981, 1982 and 1983.

MR. CHRIS HATFIELD — OIL SPILLS & RISK ASSESSMENT

Mr. Hatfield is President of Hatfield Consultants Limited of West Vancouver. He has a B.Sc. in Fisheries Zoology from the University of British Columbia (1967) and a M. Sc. in Aquatic Pollution Ecology from Queen's University in Kingston, Ontario (1970). Prior to establishing his own consulting firm in 1974, Mr. Hatfield was head of the Environmental Assessment and Oil Spill Control Program of the Environmental Protection Service (Environment Canada) in Vancouver. Mr. Hatfield's professional experience includes extensive studies and investigations of oil spills, oil spill contingency plans, oil spill risk assessment, oil spill cleanup measures and environmental resources at risk from oil spills. This experience has included work in Canada and overseas (Brazil, Venezuela and Indonesia).

DR. PETER LARKIN — FISHERIES MANAGEMENT

Dr. Larkin is Associate Vice-President, Research; Professor, Institute of Animal Resource Ecology; and Professor, Department of Zoology, all at the University of British Columbia. Dr. Larkin has a M.A. from the

University of Saskatchewan (1946) and a D.Phil. from Oxford University (1948). Prior to joining U.B.C. in 1966, Dr. Larkin spent three years as Director of the Pacific Biological Station (Fisheries Research Board of Canada) in Nanaimo.

He is currently involved in a number of off-campus activities including : Member of the Board of Directors, British Columbia Packers Limited; Member of the Canadian Committee on Seals and Sealing; Members of the Advisory Committee for the International Centre for Living Aquatic Resources Management; and Member of the Steering Committee for the Marine Recreational Fisheries Symposium. His past off-campus activities have included: Member of the National Research Council of Canada (1981-1984); Advisor to the Department of Fisheries and Oceans, on the Salmon Enhancement Program (1974 — 1978); Executive of the Board (1972-1975) and Chairman, Resource Management Committee (1973-1977) to the Fisheries Research Board of Canada; and Member of the Science Council of Canada (1971-1977). Dr. Larkin's main areas of research interest are mathematical modelling of fish population dynamics, theory of resource management, predator-prey relations, science policy mechanisms and research management.

DR. TIM PARSONS — BIOLOGICAL OCEANOGRAPHY

Dr. Parsons is a Professor of Zoology and Oceanography at the University of British Columbia. He received his B.Sc. (1953), M.Sc. (1955), and Ph.D. (1958) from McGill Univesity. Prior to joining the University in 1971, he was a research scientist with the Fisheries Research Board in Nanaimo (1958-1962 and 1964-1971) and a program specialist with UNESCO in Paris from 1962-1964. He was President and Executive Officer of the American Society of Limnology and Oceanography (1969-1972); President of the International Association for Biological Oceanography (1976-1982); and has been a member (since 1973) of the Comite de Perfectionnement de l'Institut Oceanographique (Paris). He is also a member of the Scientific Committee on Oceanic Research and the Fisheries and Oceans Research Council. Dr. Parsons' main professional and research interests are biological oceanography, marine pollution, fisheries oceanography and oceanographic education.

MR. IAN ROBERTSON — COASTAL BIRDS

Mr. Robertson is an independent environmental consultant specializing in marine wildlife and environmental emergencies. He obtained a M.Sc. in Zoology from the University of British Columbia in 1971. He has worked for both government and environmental consultants before establishing his own consulting practice in 1983. He has been involved in numerous studies dealing with coastal birds including: an inventory of West Coast seabirds; a study on fish-eating birds and their interactions with herring; a study on marine birds in the Strait of Georgia; and a study on oiled birds in Vancouver Harbour. He worked for the Environmental Protection Service of Environment Canada between 1974 and 1978, and for part of that time, was Manager of the Environmental Emergencies Branch.

MR. DAVID THOMAS — CHEMICAL OCEANOGRAPHY

Mr. Thomas is a consultant in the fields of chemical oceanography and marine geochemistry. He received his B.Sc. from Queen's University in 1972 and his M.Sc. (in chemical oceanography) from the University of British Columbia in 1975. His research has emphasized heavy metal geochemistry, sediment - seawater interactions and contaminant fluxes in temperate and polar estuarine systems. Included in his studies have been various projects at the basic research level in the laboratory and numerous field studies throughout the Arctic and along the British Columbia coast. Since 1972, Mr. Thomas has participated as a senior scientist on approximately 30 oceanographic cruises involving chemical, physical, biological and geological studies and has served as principal investigator on more than 50 projects in the ocean sciences including oceanographic instrumentation development. In recent years Mr. Thomas has specialized in environmental impact assessment and environmental monitoring.

APPENDIX D

EVENTS IN THE REVIEW PROCESS

June 1984

Panel appointed by Canada and British Columbia Ministers of the Environment. This appointment was based on a Memorandum of Agreement, signed in September 1983 by the federal and provincial Energy Ministers, which established the basis for the Panel review. In appointing the Panel, the two Ministers issued it with Terms of Reference.

September 1984

Panel released Operational Procedures which provided information on how the Panel planned to conduct its review and outlined the procedures it intended to follow.

October 1984

Panel travelled to England, Scotland and Norway to visit North Sea offshore production facilities and meet with officials involved in the North Sea oil and gas development. The main purpose of this trip was to enable the Panel to see first-hand an active offshore development area, how the environmental and socio-economic issues were being handled, and what lessons might be applied to the west coast offshore exploration program.

October 1984

Panel released (in draft form) its Requirements for Additional Information (from Industry and Government). Review participants were invited to comment on this draft document either in writing or during the Public Information Meetings.

November 2, 1984

Petro-Canada announced its intention to withdraw from the Panel review process, leaving Chevron as the only proponent still active in the review.

November 5, 1984 - November 20, 1984

Panel held Public Information Meetings in a total of 14 north coast communities as well as Vancouver and Victoria. The purpose of these meetings was to :

—allow Chevron to describe its plans for a renewed offshore exploration program

—allow the Panel to describe and discuss its review mandate

—allow for public discussion of the Panel's draft Requirements for Additional Information

December 7, 1984

Panel released its finalized Requirements for Additional Information. This document contained a series of questions and requests for additional information to be responded to by Chevron and by a number of federal and provincial government agencies.

February 1985

Two responses to the Panel's Requirements for Additional Information received: one from Chevron, and the other a consolidation of all federal and provincial government agency responses. These documents were distributed to review participants in late February.

February 1985

Panel released its Procedures for General and Community Hearings. These Procedures were amended slightly in August.

March to May 1985

Panel held a Pre-Hearing Meeting with a number of key review participants on March 19, 1985. Representations were made to the Panel at that meeting and in subsequent letters calling for a time extension to the review process to allow the hearings, which were scheduled at that time for the Spring of 1985, to be delayed to the Fall. The Panel wrote on April 12, 1985 to the federal and provincial Environment Ministers asking that consideration be given to extending the review process to allow for more effective public involvement. The Ministers responded (letters dated May 3, 1985) by extending the Panel's reporting deadline to November 30, 1985.

March 27 to April 16, 1985

Panel Secretariat held a series of Community Workshops in a number of north coast communities to encourage and facilitate public participation in the hearings.

July 1985

Panel announced its schedule for Community and General Hearings to be held in September and October.

September to November 1985

Hearings held in accordance with the following schedule:

Community Hearings:

September 9	Alert Bay
September 10	Fort Rupert
September 11	Bella Coola
September 12	Waglisla
September 13	Klemtu
September 14	Kitimat
September 15	Kitamaat Village
September 16	Hartley Bay
September 17	Kitkatla
September 18	Port Simpson
September 19	Kincolith
September 20	Masset
September 21	Queen Charlotte City
September 21	Skidegate

General Hearings:

September 10	Port Hardy
September 30 & October 1	Queen Charlotte City
October 2	Skidegate
October 4, 5 & 7	Prince Rupert
October 21 — 23	Vancouver
October 24 — 26	Victoria
October 28, 29	Vancouver
November 13 — 15, & 25	Vancouver

APPENDIX E

HEARINGS PARTICIPANTS

I GENERAL HEARINGS

PORT HARDY — SEPTEMBER 10, 1985

Dickinson, Bill	resident
Haines, Pat	Chevron
McCaffery, Ron	Port Hardy and District Chamber of Commerce
Pockrant, Harvey	Chevron
Russel, Tom	Pacific Trollers Association
Spearing, Ted	Chevron
Welchman, Brian	District of Port Hardy

QUEEN CHARLOTTE CITY — SEPTEMBER 30, 1985 TO OCTOBER 1, 1985

Boydell, Tony	Environment Canada
Brandon, Leo	Canada Oil and Gas Lands Administration
Broadhead, John	Islands Protection Society
Cohen, Phil	Environment Canada
Corwin, Ruthann	Council of the Haida Nation
Cudby, Ernie	Chevron
Durie, Bob	Ministry of Energy, Mines and Petroleum Resources
Duval, Wayne	Environmental Services Ltd.
Ford, John	Technical Specialist
Gathercole, Richard	Islands Protection Society
Grzybowski, Alex	Islands Protection Society
Hamel, Peter	Anglican Church of Canada
Hardie, Duncan	Canada Oil and Gas Lands Administration
Hatfield, Chris	Technical Specialist
Hearne, Margo	Delkatla Wildlife Sanctuary
Hornal, Bob	Canada Oil and Gas Lands Administration
Kaiser, Gary	Environment Canada
Langford, Bob	Ministry of Environment
McAuliffe, Clayton	Chevron Oil Fuel Research Company
Miles, Dave	Chevron
Millen, John	Environment Canada
Morninglight, Pamela	resident
Morris, Mary	resident
Pearse, Tony	Council of the Haida Nation
Rettie, Roy	Chevron
Richardson, Miles	Council of the Haida Nation
Robertson, Ian	Technical Specialist
Ruel, Maurice	Canada Oil and Gas Lands Administration
Spearing, Ted	Chevron
Taschereau, Maurice	Canada Oil and Gas Lands Administration
Thomas, David	Technical Specialist
Thorne, Gerry	Island Protection Society
Webb, Bob	Webb Environmental Service
Whitney, Al	Pacific Synergies
Wiebe, John	Environment Canada
Yeomans, Tim	Islands Protection Society

SKIDEGATE — OCTOBER 2, 1985

Bell, Lily	Anglican Church of Canada
Corwin, Ruthann	Council of the Haida Nation
Cudby, Ernie	Chevron
Davidson, Alfred	Anglican Church of Canada
Durie, Robert	Ministry of Energy, Mines and Petroleum Resources
Gillie, Mavis	Anglican Church of Canada
Grzybowski, Alex	Islands Protection Society
Guujaaw	Council of Haida Nation
Hamel, Peter	Anglican Church of Canada
Hatfield, Chris	Technical Specialist
Hearne, Margo	Delkatla Wildlife Sanctuary
Hoar, Rick	Delkatla Wildlife Sanctuary
Israel, Kent	Diocese of Caledonia
McAuliffe, Clayton	Chevron Oil Fuel Research Company
Miles, Dave	Chevron
Morninglight, Pamela	resident
Morninglight, Steven	resident
Pearse, Tony	Council of the Haida Nation
Plumb, Don	resident
Rettie, Roy	Chevron
Rowe, Art	Anglican Church of Canada
Spearing, Ted	Chevron
Tarver, Charlotte	resident
Thorne, Gerry	Islands Protection Society
Webb, Bob	Webb Environmental Service
Whitney, Al	Pacific Synergies
Whitney, Colbert Irene	Pacific Synergies
Wunce, Gary	resident

PRINCE RUPERT — OCTOBER 4, 5, 7, 1985

Beal, Bob	Atmospheric Environment Service
Bedard, Ken	United Fishermen & Allied Workers Union
Beech, Fred	Environment Canada

Birtwell, Ian	Department of Fisheries and Oceans
Degans, James	Nisga'a Tribal Council
Durie, Robert	Ministry of Energy, Mines and Petroleum Resources
Elford, Hans	resident
Fallon, Tony	Chevron
Flynn, Mike	Department of Fisheries and Oceans
Hardie, Duncan	Canada Oil and Gas Lands Administration
Hatfield, Chris	Technical Specialist
Langford, Bob	Ministry of Environment
Larkin, Peter	Technical Specialist
McAllister, Cary	Department of Fisheries and Oceans
McAuliffe, Clayton	Chevron Oil Fuel Research Company
Miles, Dave	Chevron
Millen, John	Environment Canada
Parsons, Tim	Technical Specialist
Rettie, Roy	Chevron
Richardson, Miles	Council of the Haida Nation
Robinson, Tom	Offshore Alliance of Aboriginal Nations
Smith, Steven	Prince Rupert Chamber of Commerce
Spearing, Ted	Chevron
Spence, Wilbur	Port Simpson Band Council
Wells, Gary	Environment Canada
Wiebe, John	Environment Canada
Wilson, Robert	Department of Fisheries and Oceans
Wytenbroek, John	Northern Native Fishing Corp.
Yates, Leslie	Prince Rupert Chamber of Commerce

VANCOUVER — OCTOBER 21, 24, 28, 29 and NOVEMBER 13, 14, 15, 25, 1985

Aldridge, Jim	Nisga'a Tribal Council
Andrews, Bill	Offshore Alliance
Argue, Sandy	Nisga'a Tribal Council
Atleo, Cliff	Native Brotherhood of British Columbia
Bannister, Bill	Chevron
Birtwell, Ian	Department of Fisheries and Oceans
Boyd, Forbes	Department of Fisheries and Oceans
Boydell, Tony	Environment Canada
Brandon, Leo	Canada Oil and Gas Lands Administration
Broadhead, John	Islands Protection Society
Brown, Anja	Heiltsuk Cultural Education Centre
Chamut, Pat	Department of Fisheries and Oceans
Collins, Mick	Ministry of Tourism
Cornu Le, Adrian	resident of Hydaburg, Alaska
Corwin, Ruthann	Council of the Haida Nation
Crawford, William	Department of Fisheries and Oceans
Darling, Jim	Technical Specialist
Davis, Rolf	LGL Environmental Services Ltd.
Davitt, Bill	Chevron
Durie, Robert	Ministry of Energy, Mines & Petroleum Resources
Englehardt, Reiner	Canada Oil and Gas Lands Administration
Erickson, Diane	Technical Specialist
Fallon, Tony	Chevron
Fingas, Merv	Environment Canada
Fissel, David	Technical Specialist
Flynn, Mike	Department of Fisheries and Oceans
Foster, Bristol	Offshore Alliance
Friele, Pierre	Student
Gathercole, Richard	Islands Protection Society
Gillis, Daniel	Kwakiutl District Council
Giovando, Larry	Department of Fisheries and Oceans
Hardie, Duncan	Canada Oil and Gas Lands Administration
Harding, Lee	Environment Canada
Hatfield, Chris	Technical Specialist
Hawksworth, Cynthia	Ministry of Municipal Affairs
Hearne, Margo	Delkatla Wildlife Sanctuary
Hindle, Lonnie	Department of Fisheries and Oceans
Hindmarch, Ken	Ministry of Energy, Mines & Petroleum Resources
Hyntka, Jean	Sierra Club of Western Canada
Kaiser, Gary	Environment Canada
Langford, Bob	Ministry of Environment
Larkin, Peter	Technical Specialist
Lightbown, Lavinia	Council of the Haida Nation
Lucas, Simon	Nuu-chah-Nulth Tribal Council
Maxwell, Bill	Seaman
McAllister, Kerry	Department of Fisheries and Oceans
McAuliffe, Clayton	Chevron Oil Fuel Research Company
McDougall, Rick	R. D. McDougall and Associates
Miekle, Ken	Environment Canada

Miles, Dave	Chevron
Millen, John	Environment Canada
Nassichuk, Mike	Department of Fisheries and Oceans
Nichol, Michael	Council of the Haida Nation
Nyce, Harry	Nisga'a Tribal Council
Oberhoffner, Joe	British Columbia Chamber of Commerce
O'Riordan, Jon	Ministry of Environment
Parsons, Tim	Technical Specialist
Pearse, Tony	Council of the Haida Nation
Pond, Steve	Environment Canada
Rettie, Roy	Chevron
Roberts, Kim	Kwakiutl District Council
Robertson, Ian	Technical Specialist
Robinson, Rod	Nisga'a Tribal Council
Ross, Sy	Chevron
Ruel, Maurice	Canada Oil and Gas Lands Administration
Schaefer, Val	Vancouver Natural History Society
Solsberg, Laurie	Hatfield Consultants
Spearing, Ted	Chevron
Speck, Wedlidi	Kwakiutl District Council
Stewart, Charlie	Chevron
Stocker, Don	Department of Fisheries and Oceans
Suzuki, David	Islands Protection Society
Szollosy, David	Diocese of Victoria, Catholic Church
Taschereau, Maurice	Canada Oil and Gas Lands Administration
Thomas, David	Technical Specialist
Thorne, Gerry	Islands Protection Society
Wiebe, John	Environment Canada
Williams, John	resident
Williams, Susan	Islands Protection Society
Wilson, Don	Chevron
Wilson, Robert	Department of Fisheries and Oceans
Young, Ian	Canadian Coast Guard

VICTORIA — OCTOBER 24, 25, 26, 1985

Ages, Al	Department of Fisheries and Oceans
Albertson, Paul	Provincial Emergency Program
Aldridge, Jim	Nisga'a Tribal Council
Andrews, Bill	Offshore Alliance
Billard, Allan	East Coast Fishermen's Federation
Birtwell, Ian	Department of Fisheries and Oceans
Boyd, Forbes	Department of Fisheries and Oceans
Burgess, Mike	Fisheries Council of British Columbia
Burns, Allan	State of Oregon Coastal Management Agency
Corwin, Ruthann	Council of the Haida Nation
Crawford, Bill	Department of Fisheries and Oceans
Cudby, Ernie	Chevron
Durie, Robert	Ministry of Energy, Mines and Petroleum Resources
Englehardt, Reiner	Canada Oil and Gas Lands Administration
Erickson, Diane	Technical Specialist
Fingas, Merv	Environment Canada
Fissel, David	Technical Specialist
Gathercole, Richard	Islands Protection Society
Gillie, Mavis	Project North
Gillis, Dan	Kwakiutl District Council
Hamel, Peter	Anglican Church of Canada
Harding, Lee	Environment Canada
Hearne, Margo	Delkatla Wildlife Sanctuary
Hindle, Lonnie	Department of Fisheries and Oceans
Hindmarch, Ken	Ministry of Energy, Mines and Petroleum Resc.
Hnytka, Jean	Sierra Club of Western Canada
Hunter, George	Department of Fisheries and Oceans
Jansen, Gerard	Port Alberni Chamber of Commerce
Kaiser, Gary	Environment Canada
King, Walter	Georgetown Mills River Resources Limited
Kopas, Paul	Department of Fisheries and Oceans
Kunkel, Lois	Project North
Langford, Bob	Ministry of Environment
Leitch, Gary	Canadian Petroleum Division
McAllister, Cary	Department of Fisheries and Oceans
McAuliffe, Clayton	Chevron Oil Fuel Research Company
McKay, Will	Kwakiutl District Council
Meikle, Ken	Environment Canada
Miles, Dave	Chevron
Millen, John	Environment Canada
Mukherjee, P. K.	Department of Fisheries and Oceans
Nichol, Michael	Council of the Haida Nation
Nyce, Harry	Nisga'a Tribal Council
O'Riordan, Jon	Ministry of Environment
Parsons, Tim	Technical specialist
Pashelka, Dick	Chevron
Pearse, Tony	Council of the Haida Nation
Plante, Lorraine	Nisga'a Tribal Council

Pockrant, Harvey	Chevron
Pond, Steve	Environment Canada
Rettie, Roy	Chevron
Rice, Stanley	Northwest and Alaska Fisheries Centre
Roberts, Kim	Kwakiutl District Council
Robinson, Ray	Federal Environmental Assessment Review Office
Rooney, Sister Cecilia	Project North
Schaeffer, Marvin	Nisga'a Tribal Council
Smith, Moses	Nuu-chah-Nulth Tribal Council
Spearing, Ted	Chevron
Steele, Jim	Council of the Haida Nation
Stocker, Don	Department of Fisheries and Oceans
Szollosy, David	Diocese of Victoria, Catholic Church
Thomas, Dave	Technical Specialist
Thorne, Gerry	Islands Protection Society
Walker, Jim	Ministry of Environment
Watts, George	Nuu-chah-Nulth Tribal Council
White, Jim	Project North
Wiebe, John	Environment Canada
Wilson, Robert	Department of Fisheries and Oceans
Wolferstan, Bill	Ministry of Environment
Young, Ian	Canadian Coast Guard

II COMMUNITY HEARINGS

ALERT BAY — SEPTEMBER 9, 1985

Cudby, Ernie	Chevron
Haines, Pat	Chevron
Pockrant, Harvey	Chevron
Spearing, Ted	Chevron
Thurber, Bob	Nimpkish Indian Band
Williamsom, Maxine	Regional District of Mt. Waddington

FORT RUPERT — SEPTEMBER 10, 1985

Hunt, William	Kwakiutl District Council
Sieley, James	Kwakiutl District Council
Speck, Wedlidi	Kwakiutl District Council
Wallace, James	Kwakiutl District Council

BELLA COOLA — SEPTEMBER 11, 1985

Corrigan, Keith	resident
Davitt, Bill	Chevron
Haines, Pat	Chevron
Karup, Mr.	resident
O'Neill, Kevin	Central Coast Fishermens' Protective Assoc.
Spearing, Ted	Chevron

WAGLISLA — SEPTEMBER 12, 1985

Brown, Anja	Heiltsuk Cultural Educational Centre
Carpenter, Jennifer	Heiltsuk Band
Davitt, Bill	Chevron
Innes, Mel	resident
Rath, John	resident
Reid, Cecil	Bella Bella Band Council
Spearing, Ted	Chevron

KLEMTU — SEPTEMBER 13, 1985

Davitt, Bill	Chevron
Kraft, B.	resident
McKenzie, Donald	Kitasoo Band Store
Mason, Ernie Jr.	Kitasoo Band Council
Robinson, Archie	Kitasoo Band Council
Robinson, F.	Kitasoo Band Council
Starr, Percy	Kitasoo Band Council

KITIMAT — SEPTEMBER 14, 1985

Beck, Detlef	District of Kitimat
Horwood, Dennis	resident
Kline, Kelly	resident
McClellan, Walter	District of Kitimat
Spearing, Ted	Chevron
Tirrul-Jones, James	resident

KITAMAAT VILLAGE — SEPTEMBER 15, 1985

Amos, Gerald	Kitamaat Village Council
Davitt, Bill	Chevron
Maitland, Heber	Kitamaat Village Council
Spearing, Ted	Chevron

HARTLEY BAY — SEPTEMBER 16, 1985

Davitt, Bill	Chevron
Fisher, Dwayne	resident
Hill, Lynn	Hartley Bay Band Council
Pockrant, Harvey	Chevron
Reece, Dan	resident
Schoenhoff, Steve	resident
Spearing, Ted	Chevron
Sullivan, Tim	resident
Wilson, Ron	resident
Wilson, L.	resident

KITKATLA — SEPTEMBER 17, 1985

Davitt, Bell	Chevron
Hill, Matthew	Kitkatla Band Council
Lewis, Francis	resident
Pockrant, Harvey	Chevron

PORT SIMPSON — SEPTEMBER 18, 1985

Bryant, James	resident
Davitt, Bill	Chevron
Kemnitz, Roger	resident
Robinson, William	resident
Spearing, Ted	Chevron
Spence, Wilbur	Native Brotherhood Local
Walters, Dave	resident

KINCOLITH — SEPTEMBER 19, 1985

Alexander, Sydney	resident
Azak, Alven	resident
Benson, Chester	resident
Davitt, Bill	Chevron
LaFrance, Andre	resident
Leeson, Nelson	resident
McKay, Hans	Greenville Deputy Chief Councilor
Moore, Allan	resident
Moore, Graham	resident
Nelson, F.	Kincolith Band Chairman
Nyce, Harry	resident
Plante, Lorraine	resident
Pockrant, Harvey	Chevron
Robinson, Rod	Nisga'a Tribal Council
Spearing, Ted	Chevron
Stevens, Chief	resident
Watts, Rufus	resident
Woods, Leslie	resident
Wright, Basil	resident
Wright, Harold	resident

MASSET — SEPTEMBER 20, 1985

Broadhead, John	Islands Protection Society
Collison, Frank	resident
Cudby, Ernie	Chevron
Good, John	resident
Hearne, Margo	Delkatla Wildlife Sanctuary
Henley, Thom	Rediscovery Society
Histed, Brenda	resident
Medley, Andy	resident
Miles, Dave	Chevron
Pashelka, Dick	Chevron
Phillips, David	resident
Pinker, Wilfred	resident
Spearing, Ted	Chevron

QUEEN CHARLOTTE CITY — SEPTEMBER 21, 1985

Cassidy, Brad	resident
Cudby, Ernie	Chevron
Fowler, Fran	resident
Miles, Dave	Chevron
Morninglight, Pamela	resident
Sexsmith, Vicki	Islands Protection Society
Suna, Susanne	resident
Walker, Eevan	resident

SKIDEGATE — SEPTEMBER 21, 1985

Adams, Victor	Council of the Haida Nation
Collison, Frank	Council of the Haida Nation
Richardson, Miles	Council of the Haida Nation

APPENDIX F

REPORTS, BACKGROUND DOCUMENTS & MISCELLANEOUS MATERIAL RECEIVED BY PANEL

I. REPORTS & BACKGROUND DOCUMENTS

1. Petro-Canada Inc. 1983. Offshore Queen Charlotte Islands : Initial Environmental Evaluation. Volumes 1, 2 & 3 (in separate binders).

2. Chevron Canada Resources Ltd. 1982. Initial Environmental Evaluation for Renewed Petroleum Exploration in Hecate Strait and Queen Charlotte Sound. Volumes 1 & 2 (in one binder).

3. British Columbia Ministry of Environment. 1983. Offshore Hydrocarbon Exploration and Development: A Preliminary Environmental Assessment.

4. Canada Oil and Gas Lands Administration and British Columbia Ministry of Energy, Mines and Petroleum Resources. 1984. Technical Evaluation of the IEEs for Offshore Petroleum Exploration — Victoria, January 17/18, 1984.

5. Chevron Canada Resources Ltd. February 20, 1985. West Coast Offshore Exploration : Response to Requirements for Additional Information.

6. Government of Canada and Province of British Columbia. February, 1985. West Coast Offshore Exploration : Government Responses to Requirements for Additional Information.

7. Environment Canada Background Reports, Offshore Exploration - West Coast Review :

Report No. 1

Colonial Alcids in British Columbia, Gary Kaiser, Canadian Wildlife Service, July, 1985.

Report No. 2

Dispersant Use Seminar, Summary Proceedings, March 20-21, 1985, Institute of Ocean Sciences, Sidney, British Columbia.

Report No. 3

An Evaluation of the Effects of Averaging Time on the Wind Statistics of the North Coast of Britsh Columbia, prepared for the Atmospheric Environment Service by Environmental Sciences Limited, March 15, 1985.

Report No. 4

Severe Storms off Canada's West Coast : A Catalogue Summary for the Period 1957 to 1963,prepared for the Atmospheric Environment Service by Concord Scientific Corporation, January, 1985.

Report No. 5

Observations of Sea Spray Icing on Green Island, British Columbia (1984 — 1985), prepared for the Atmospheric Environment Service by Environment Sciences Limited, April 30, 1985.

Report No. 6

Environmental Sensitivity to Oil Spills of The Queen Charlotte Islands Area, prepared by Dr. Cohen and J. Slater, August, 1985.

Report No. 7

Distribution and Densities of Marine Birds on the Canadian West Coast, Canadian Wildlife Service.

Report No. 8

Preliminary Estimates of Exploration and Production Oil Spill Probabilities for The Queen Charlotte Islands Offshore Area, October 10, 1985.

Report No. 9

Guide to the Preparation of Shoreline Protection and Cleanup Manuals, Environmental Protection Service, November, 1981.

8. Dr. Clayton McAuliffe, Chevron. Crude Oil and Salmon - Effects of Untreated and Chemically Dispersed Prudhoe Bay Crude on Homing, and Amounts Lethal to Salmon Adults and Fry.

9. Dr. Clayton McAuliffe, Chevron. Fate and Effects of an Oil Spill from Canadian West Coast Offshore Exploration.

10. Dr. Clayton McAuliffe, Chevron. Summary of Studies by Pearson et al. (1985) on the Effects of Prudhoe Bay Crude Oil on Egg Fertilization, Hatching and Larval Abnormalities of Pacific Herring.

11. Department of Fisheries and Oceans. October 16, 1985. Supplementary Oceanographic Information on Waves and Currents.

12. Dr. Clayton McAuliffe, Chevron. Hypothetical Oil Blowout: Model Crude Oil, Its Fate and Effects. (This was supplied by Chevron August 23, 1985 and was intended to correct an error in Section 4 of Chevron's Initial Environmental Evaluation.)

13. Canada Oil and Gas Lands Administration and B. C. Ministry of Energy, Mines and Petroleum Resources. June 28, 1985. Additional information on oil-based drilling muds, hazard maps and environmental impacts on surface feeding and near-shore marine sea birds and herring.

14. Environment Canada. August, 1985. Additional Information on West Coast Marine Forecast Verification and West Coast Marine Weather Services Improvements Planned.

15. Department of Fisheries and Oceans. September 30, 1985. Responses to The Panel's Supplemental Information Requirement.

16. Department of Fisheries and Oceans. Letter dated May 30, 1985. List of errors and omissions on the fisheries resource maps submitted to the Panel as part of the Department's contribution to the Government Responses to Requirements for Additional Information.

17. Canada Oil and Gas Lands Administration and B. C. Ministry of Energy, Mines and Petroleum Resources. June 28, 1985. Information submitted in response to the Panel's request for an expanded oil spill scenario.

18. Batelle Marine Research Laboratories. May, 1985. Draft report to the American Petroleum Institute on Oil Effects on Spawning Behaviour and Reproduction in Pacific Herring.

19. American Petroleum Institute. May 10, 1985. The Role of Chemical Dispersants in Oil Spill Control (Draft).

20. Fisheries Research Institute, University of Washington. August, 1985. Draft report prepared for the American Petroleum Institute on Effects of Prudhoe Bay Oil on the Homing of Coho Salmon in Marine Waters.

21. American Petroleum Institute with assistance from the Fisheries Research Institute, University of Washington. October, 1985. Effects of Crude Oil and Chemically Dispersed Oil on Chemoreception and Homing in Pacific Salmon.

II. SUBMISSIONS

1. Compendium of Written Submissions to the Panel on the Draft Information Requirements (19 submissions — 317 pages). September 27, 1984.

2. Compendium of Written Responses to the Panel's Draft Information Requirements (16 submissions — 111 pages). December 6, 1984.

3. Compendium of Submissions Received by the Panel At or During Public Information Meetings (19 submissions — 125 pages). December 6, 1984.

4. Brief from the District of Port Hardy. August 29, 1985. (PH- 1).

5. Submissions Received at the Queen Charlotte City General Hearings. September 30 — October 2, 1985 :

QCC-1 — Opening Statement by M. E. Taschereau, Administrator, Canada Oil and Gas Lands Administration.

QCC-2 — Opening Statement by Dr. Robert W. Durie, Assistant Deputy Minister, Ministry of Energy, Mines and Petroleum Resources, September 18, 1985.

QCC-3 — Technical Submission on the Impacts of Offshore Petroleum Exploration and Development on the Nonconsumptive Resources of the North Coast and the Queen Charlotte Islands, Alex Grzybowski, October, 1985.

QCC-4 — Submission by Pamela Morninglight.

QCC-5 — Delkatla Wildlife Sanctuary Presentation, October 1, 1985.

QCC-6 — Some Moral and Ethical Considerations Relating to the Assessment of Proposed West Coast Offshore Petroleum Exploration, The Anglican Diocese of Caledonia, The Unit on Public Social Responsibility of the Anglican Church of Canada, October 2, 1985.

QCC-7 — Concerns Regarding the Development of Offshore Oil and Gas in the Area of the Queen Charlotte Islands and its Specific and Negative Impacts on Wilderness Tourism, Dr. Alan G. Whitney, Pacific Synergies Ltd., October, 1985.

QCC-8 — Opening Statement of the Council of the Haida Nation, September 30, 1985.

QCC-9 — Environmental and Regulatory Concerns of Offshore Oil and Gas Development, Presented by Ruthann Corwin, Ph.D., on behalf of the Council of the Haida Nation, October, 1985.

QCC-9A — Four attachments to the Council of the Haida Nation submission (QCC-9).

QCC-9B — Resume, Dr. Ruthann Corwin.

QCC-10 — Opening Statement by Dr. A. N. Boydell, Regional Director General, Pacific and Yukon Region, Environment Canada, September 30, 1985.

QCC-11 — British Columbia Ministry of Environment Opening Statement

QCC-12 — Summary of Environment Canada Report, "Environmental Sensitivity to Oil Spills of the Queen Charlotte Islands," Dr. P. Cohen and J. Slater, August, 1985.

QCC-13 — Council of the Haida Nation Statement to All Member States of the United Nations International Law of the Sea.

6. Submissions Received at the Prince Rupert General Hearings, October 4, 5 & 7, 1985:

PR-1 — Offshore Alliance of Aboriginal Nations Position on Offshore Hydrocarbon Exploration off the Pacific Coast, September 18, 1985.

PR-2 — Brief from the Prince Rupert Chamber of Commerce, October 4, 1985.

PR-3 — Brief submitted by the United Fishermen and Allied Workers Union, Northern Office, Prince Rupert, October 7, 1985.

PR-4 — Submission from the Northern Native Fishing Corporation, September 30, 1985.

PR-5 — City of Prince Rupert Submission, October, 1985.

7. Submissions Received at the Vancouver and Victoria General Hearings, October 21 — November 15, 1985 :

V-1 — Submission of the Nisga'a Tribal Council, October, 1985.

V-2 — Submission from the Vancouver Natural History Society, September 30, 1985.

V-3 — Statement to the Panel from the Office of Environmental Affairs, Department of Energy, Mines and Resources, October 3, 1985.

V-4 — West Coast Oil and Gas Exploration, a position paper submitted by the Fisheries Council of British Columbia.

V-5 — Canadian Petroleum Association, Offshore Operators Division, Fishermen's Compensation Policy for Unattributable Damage due to Exploration and Production Activities on Canada's East Coast.

V-6 — The Bella Bella Native Food Fishery, Anja Brown, Heiltsuk Cultural Education Centre, August 13, 1985.

V-7 — Final Submission to the Panel by Environment Canada, September 18, 1985.

V-8 — Department of Fisheries and Oceans' Position on Proposed West Coast Offshore Hydrocarbon Exploration, October, 1985.

V-8A — French version of V-8.

V-8B — Notes on Current Observations in Queen Charlotte Island, Hecate Strait and Dixon Entrance, Dr. W. R. Crawford, Institute of Ocean Sciences, Department of Fisheries and Oceans, October, 1985.

V-9 — Ministry of Environment Presentation, October, 1985.

V-10 — The British Columbia Chamber of Commerce, Brief on West Coast Offshore Exploration, October 23, 1985.

V-11 — Environmental Issue Management for British Columbia Offshore Oil Exploration prepared by British Columbia Ministry of Environment, Environment Canada and the Department of Fisheries and Oceans, October, 1985.

V-12 — Outline of Presentation to the Panel submitted jointly by British Columbia Ministry of Energy, Mines and Petroleum Resources and Canada Oil and Gas Lands Administration.

V-12A — Drilling for Oil and Gas on Canada Lands, Guidelines Procedures, Canada Oil and Gas Lands Administration, September, 1984.

V-13 — Executive Summary, Nuu-Chah-Nulth Tribal Council Submission, October, 1985.

V-14 — Marine Birds and West Coast Offshore Hydrocarbon Development, A Statement of Evidence Prepared for Islands Protection Society by Peter Hamel, October 2, 1985.

V-15 — Islands Protection Society Presentation — Marine Benthos.

V-16 — Final Evidence of the Kwakiutl District Council, October, 1985.

V-17 — Islands Protection Service Presentation — Environmental concerns of Marine Seismic Exploration Techniques.

V-18 — Islands Protection Society Presentation — Marine Mammals and Cetaceans.

V-19 — The Importance of the Environment North of Vancouver Island, a presentation by Dr. Bristol Foster.

V-20 — Submission from the Sierra Club of Western Canada.

V-21 — Department of Fisheries and Oceans Opening Statement, October 21, 1985.

V-22 — Some Ethical Considerations on the Socio-Economic Implications of Proposed West Coast Offshore Petroleum Exploration: A Statement by the Social Justice Commission of the Catholic Diocese of Victoria, October 17, 1985.

V-23 — Department of Fisheries and Oceans Remarks on Oil Blow-Out Impacts, October 23, 1985.

V-24 — The Effectiveness of Oil Spill Dispersants by Merv Fingas, Environmental Protection Service, Environment Canada.

V-25 — The Socio-Economic Impacts of the Proposed West Coast Offshore Petroleum Exploration on the British Columbia Coast, Project North, October 26, 1985.

V-26 — Submission from the Alberni Valley Chamber of Commerce, October 25, 1985.

8. Submission Prepared by David Fraser, Port Alberni, October 20, 1985.

9. Submission from Mr. Rick McDougall of R. D. McDougall & Associates with information on Canada's Pacific Coast Fisheries and Competing Resource Uses Map, August 15, 1985.

10. Submission from Ms. Carol Anne Rolf in the form of a paper entitled Mandatory Negotiation: A Means to Determine Mitigation and Compensation Measures in the Context of Energy Development.

11. Submission from the British Columbia Lifeboat Society, November, 1985.

12. Department of Fisheries and Oceans Closing Statement, November 25, 1985.

13. Council of the Haida Nation, Closing Statement, November 30, 1985.

14. Compendium of Submissions at the Community Hearings (eight submissions — 25 pages)

APPENDIX G

GLOSSARY OF TERMS

Amphipods Tiny crustaceans, about 5 to 10 mm in length, with short antennae and flattened bodies, which feed on detritus and are the food of many marine animals.

Anadromous Pertaining to fish species, such as salmon, which spend most of their life in the marine environment but return to fresh water to spawn.

Annulus (Drill pipe, casing) The space in an open hole between the wall of the hole and the steel assembly in the hole; the space in a cased hole between the inside of the casing and the outside of whatever assembly is within the casing.

Ball Joint In offshore drilling, the quick release universal joints at each end of the marine riser linking the drill unit to the BOPs on the seabed.

Benthic Occurring at the ocean bottom.

Bit The cutting tool at the bottom of the drilling assembly which is rotated, weighted and mud-flushed to break-up the rock face.

Blowout Preventers (BOPs) The assembly mounted on the smallest casing head protruding from the seabed, which is capable, by hydraulic activation of rams from the surface, of sealing an empty hole, closing off around any tool in the drilled hole and thus sealing the annulus, and cutting through (shearing) any tool in the hole, dropping it down and again sealing the hole. Blind, pipe and bag type valves (rams) are used. (See Section 8 for elaboration)

Casing The permanent, jointed piping installed and cemented in a well to seal it from the rock and rock fluids, to support the walls of the hole and to support the BOPs.

Casing String The whole casing assembly of threaded pipe joints being run or cemented in the drilling hole.

Casing Shoe The base of the bottom joint of the casing string, having a small diameter hole through it.

Cetaceans Aquatic marine mammals including whales, dolphins and porpoises.

Choke Assembly An assembly on the surface connected by piping to the casing below the BOPs, which controls the flow and pressure of a potential blowout when BOPs are closed.

Colloidal Suspension Very fine particles in ionic equilibrium and suspension in a holding fluid.

Crustaceans Animals with a hard outside shell, antennae, mandibles and compound eyes, living in water. These include : lobster, crab, shrimp, amphipods and barnacles.

Crustal Fault A fracture in the earth's crust across which there has been relative displacement.

Core Barrel An assembly mounted at the bottom of a drilling assembly in place of the bit which is designed to cut a cylindrical core of the rock formation rather than simply grind the face into small particles or cuttings.

Convergence Zones Regions in the ocean where water masses with different characteristics (salinity, temperature, etc.) come together. Along these lines of convergence, the denser mass will sink beneath the other.

Detritus Loose particles of organic matter from decaying plants and animals.

Diurnal Pertaining to daily occurrences.

Drill Collars Very heavy thick-walled constant diameter piping installed between the bit and the long length of drill pipe affording the ability to apply weight to the bit and cut rock formations. The whole length of the assembly, including drill collars, rotates.

Drill Pipe The major piping part of the drilling assembly in the hole which conveys rotation, mud flow and weight to the bit thus providing penetration.

Drill Ship One type of offshore supporting vessel for a drill rig, based on a floating shipshape configuration.

Drill String An expression encompassing the entire assembly from the bit at the bottom of the hole, up through drill collars, drill pipe, kelly and swivel.

Drill Unit Generally known as a "rig", this is the generic term for the entire drilling machine used offshore to drill a vertical or near vertical hole.

Ebb (Tide) Refers to the movement of water on an outwardly flowing tide.

Estuary The tidal mouth of a river.

Estuarine Circulation Where fresh water from a river, while flowing over saltwater, gradually mixes with the saltwater beneath it. The saltwater lost to the mixing is replaced by an underflow of saltwater toward the river mouth.

Euphausids Planktonic, usually luminescent, shrimp-like crustacea.

Ecosystem A complex community of organisms and the surrounding environment which function as a unit in nature.

Fetch The distance along open water or land over which the wind blows, or the distance traversed by waves without obstruction.

Flood (Tide) Refers to the movement of water on an incoming tide.

Food Chain A diagramatic presentation of a natural community, which indicates what each member eats.

FoodWeb The totality of all food chains within an ecosystem. At the bottom of the web are plants and bacteria and large carnivores are at the top.

Formation A drilling and geological term covering the rock unit in reference. The rock unit may be of variable thickness and can usually be correlated and identified over long distances.

Formation Pressure The intrinsic pressure in fluids contained in a porous and permeable formation at any given point in time.

Gooseneck The flexible armoured rubber piping leading from the discharge pipe of the rig pumps to the top of the drilling assembly (the swivel) which conveys mud from tanks, through the pumps, to the drill pipe and down the hole to the bit.

Ichthyoplankton The passively floating eggs and weakly swimming larval forms of animal life in the marine environment.

Igneous A rock formed from magmatic flow from the molten core regions of the earth.

Inertial Currents These occur in surface waters subjected to intermittent winds. The pulse of wind energy sets the water in motion which, under its own inertia, will trace out a clockwise circular path (looking downward) with a period of 15½ hours at latitude 51°N.

Jack-up A type of foundation unit supporting a drilling unit. The jack-up is bottom supported, can be floated onto a location, the legs extended to the seabed and the drilling module thereafter jacked-up out of the water.

Kelly The top joint of the whole drilling assembly. It is either square or hexagonal in section and is fitted with a loose bushing on its outside which fits into the rotary table on the rig floor and imparts a rotary motion to the Kelly and, therefore, the drill pipe, drill collars and bit. The Kelly is suspended from the swivel to which the gooseneck is attached.

Kelly Cock A valve installed at the top of and as an integral part of the Kelly which can be closed manually on the rig floor if a blowout threatens from inside the drill pipe.

Kick A gaseous or gas-oil influx into the well bore and often up the drill hole indicating a threatened blowout. It is controlled by the mud column and blowout preventers (BOPs).

Kill Line A line from the surface to below the blowout preventers on the seabed, used to introduce heavy mud into an annulus to control a blowout when preventers are closed.

Larva An embryo that is on its own before it assumes the characteristics of the adults of the species.

Light Ends A collective term for the lowest specific gravity aromatic and alkane compounds contained in natural hydrocarbons. Light ends are generally considered to be those products, in the alkane category, from C1 to C10. They include liquified natural gas and liquified petroleum gas.

Lost Circulation Certain formations of low pressure will drain mud from the hole thus reducing the mud column height and pressure and creating blowout potential.

Marine Riser A large-diameter jointed pipe assembly installed between the rig on the surface and the top of the blowout preventers at seabed, and attached by ball joints on both ends. This provides a conduit for access for the drill assembly through the blowout preventers into the drill hole and conveys return mud to the surface.

Maritime Bombs Rapidly developing storms, sometimes related to tropical weather systems which, for dynamic and thermodynamic reasons, have a sudden pressure drop within the centre of the storm, creating high winds and waves.

Molluscs Soft, unsegmented animals usually protected by a calcareous shell and having a muscular foot for locomotion. Includes snails, clams, chitons and octupus.

Mousse A water-in-oil emulsion which often forms in an oil blowout situation between the oil effluent and seawater, particularly with paraffinic oils.

Mud Drilling fluid mud weight is used to control pressure in the formations, lubricate the drill pipe assembly in the hole while drilling, improve penetration rate, and seal permeable formations. (See Section 6 Routine Exploratory Drilling and Support Operations for full description).

Pelagic Living or occurring in the open sea.

Permeability The ability of a rock to allow fluids to flow through it.

Phytoplankton Minute, passively floating plant life in the marine environment.

Porosity Some rocks contain micro-cavities which, in certain circumstances, contain hydrocarbon fluids. The ratio of micro-cavity to bulk volume is known as porosity and is expressed as a percentage.

Predacious Feeding upon other organisms.

Primary Producers The base of the food chain. In the open ocean, the phytoplankton play this role; in the nearshore environment, sea grazers and seaweeds are important primary producers.

Rotary Table The rotary table on the rig floor provides the rotary movement of the drilling assembly and bit by engagement with the bushing mounted on the hexagonal or square section Kelly.

Seismic Survey Operations Operations using soundwave speed to determine rock configurations below the seabed. Seismic survey operations have no connection with seismicity or natural earth movement and earthquake phenomena.

Slick A very thin deposit of oil on the sea surface resulting from a spill.

Slip Joint An additional joint on the marine riser associated with the ball joint, and used for rapid disconnection of the marine riser in the event of an emergency.

Sparker Survey A high resolution seismic survey technique used for well site surveys to detect shallow gas pockets. Involves generating a large electric "spark" between two electrodes underwater.

Specific Gravity The ratio of the density of a given substance to the density of water.

Squamish Winds West coast terminology for strong winds which flow down fiords and inlets toward the sea when there is a high pressure weather system over the central or northern interior of British Columbia.

Stack BOPs are mounted one above the other in a steel cage and are known as a BOP stack. (See Section 6 — Routine Exploratory Drilling and Support Operations for full description)

Swivel A swivel is mounted on top of the Kelly and conveys mud from the gooseneck to the Kelly and drill string and also permits full rotation of the entire drill string by use of the rotary table.

Tidal Range The difference in height between low tide and high tide. This varies with time of year and location.

Tidal Rips Constricted or shallow areas where tidal currents or long period gravity waves increase in speed either on ebb or flood due to the constriction.

Tsunami A seismic sea wave generated by a submarine earthquake or volcanic event. Not noticeable on the open ocean, they can build up to great heights in shallow or constricted water.

Turbidity Flow (turbidity current or suspension flow) A mud-laden or sediment-laden subsea current which occurs when enough sediment is stirred into suspension (from a sudden force such as an earthquake) such that the diluted material will flow down a submarine slope under the force of gravity. Speeds of turbidity flows have been indirectly measured at 100 km/hr and have destroyed telegraph cables on the seabottom.

Viscosity A measure of resistence to flow in a liquid.

Wave Amplitude The vertical distance between wave crests and troughs from still water. Wave amplitude is one half the wave height.

Wellhead In drilling terms, is the top of the smallest casing on the seabed, upon which is mounted the BOP stack.

Zooplankton Minute, passively floating or weakly swimming animal life in the marine environment.

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APPENDIX H

Acknowledgements

The Panel would like to extend its sincere thanks and appreciation to all those who participated in the review. Particular thanks go to those who took the time and trouble to make written submissions to the Panel or who took an active role in the public hearings.

Chevron Canada Resources Ltd. is to be especially complimented for its full cooperation and participation throughout the review. The time and effort that went into the preparation of its Initial Environmental Evaluation, responding to the Panel's requests for additional information and participating in all of the hearings is greatly appreciated.

The project initiators, the Canada Oil and Gas Lands Administration and the British Columbia Ministry of Energy, Mines and Petroleum Resources, are to be complimented for their positive and helpful contribution to the review.

The various government agencies at both the federal and provincial level played a most valuable role both prior to and during the public hearings. Their written responses to the Panel's many questions helped form the information base for the hearings and their participation in the hearings, both as intervenors and as a source of technical expertise, contributed significantly to the review.

Another major contribution to the review, both prior to and during the hearings, was made by the Technical Specialists. Their names and backgrounds are listed in Appendix C.

The many public and native groups and organizations that took part in the review are to be congratulated for their thorough and professional contributions. Their participation added substantially to the Panel's information base.

Particular thanks go out for the hospitality extended toward the Panel in the many communities and villages it visited both during the Public Information Meetings and the final public hearings.

Finally, the Panel would like to extend special thanks to its two Executive Secretaries and the other members of its Secretariat and support staff as listed below:

Executive Secretaries
  David Marshall
  Jonathan Secter

Secretariat Members
  Bob Williams
  Paul Scott
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